VAMP 221

Arc flash protection system

Publication version: V221/EN M/B019

User manual

Schneider Electric

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1. General

The main purpose of the arc protection relay is to protect an electrical installation against the destructive impact of an arc short circuit, minimize physical damages and mitigate potential injuries. The arc protection relay VAMP 221 was originally designed for this purpose.

In addition, the VAMP 221 Arc Protection System has several user-friendly features, such as four separate protection zones; current measurement indication in the central unit; versatile, partially programmable output relays; comprehensive self-supervision of functions; and the ability to interconnect VAMP protection relays and arc protection via the BI/O bus.

The VAMP 221 Arc Protection System can be easily installed on both new and existing low and medium voltage switchgear.

Software revision history

3.08 Self-supervision alarm display is manually reset only.

3.10 Detection of system fault takes about 100 seconds.

1.1. VAMP 221 arc protection system components

VAMP 221 is an easily adaptable arc protection system for the protection of electricity distribution systems. VAMP 221 significantly reduces the risk of potential personal damage, and material and production losses caused by arc fault.

VAMP 221 in a nutshell:

- system operating time 7 milliseconds
- accurate location of arc fault
- four selective protection zones
- self-supervision of the entire system
- system cabling with standard cables
- automatic system configuration
- phase current measuring
- earth-fault current measuring

VAMP 221 complies with the latest standards concerning the electromagnetic compliance (EMC) of protective relays.

VAMP 221 is a modular system consisting of a central unit, I/O units, arc sensors and possible multiplying relays.

Thanks to its modularity, the system can easily be adapted to different targets requiring arc protection, from simple systems comprising one central unit and one I/O unit to versatile selective systems comprising several central units.

The VAMP 221 arc protection system is suitable for both low and medium voltage switchgear. In addition to new switchgear, the system can also be installed on existing switchgear.

1.1.1. Central unit VAMP 221

Figure 1.1.1-1 The central unit VAMP 221

The central unit VAMP 221 contains the following functions:

- 3-phase overcurrent and arc stage
- Alternatively, 2-phase overcurrent, earth-fault and arc stage
- Circuit breaker failure protection stage (CBFP)
- Optional trip criteria (I>&L>, I_0>&L> or L>)
- Two mutually independent tripping groups
- Four output trip relays
- Four protection zones
- BI/O bus for light and overcurrent information
- Status, fault and trip indications
- Accommodates up to 16 I/O units
- System self-supervision

1.1.2. I/O units VAM 12L / VAM 12 LD, VAM 10L / VAM 10LD, VAM 3L / VAM 3LX and VAM 4C / VAM 4CD

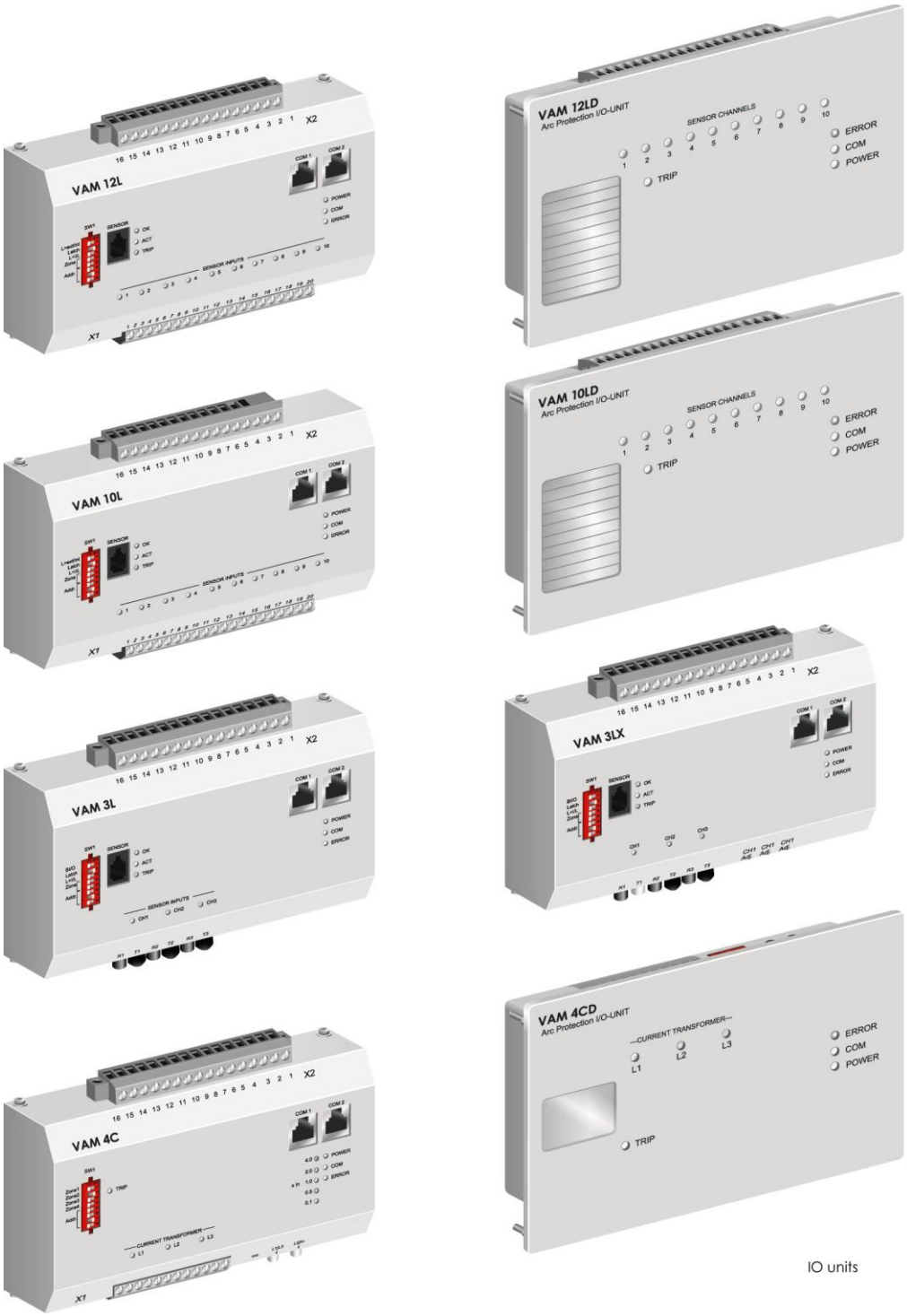


Figure 1.1.2-1 I/O units VAM 12L / VAM 12LD, VAM 10L / VAM 10 LD, VAM 3L / VAM 3LX and VAM 4C / VAM 4CD

- Sensors are connected to the central unit via I/O units.
- VAM 12L / VAM 12LD accommodates up to 10 arc sensors. 3 sensors with dedicated trip outputs.
- VAM 10L / VAM 10 LD accommodates up to 10 arc sensors
- VAM 3L accommodates up to 3 fibre loops
- VAM 3LX accommodates up to 3 fibre loops with sensitivity adjust
- VAM 4C / VAM 4CD accommodates up to 3 current transformers
- VAM 12L / VAM 12LD is equipped with 3 output trip relays
- VAM 10L / VAM 10 LD, VAM 3L / VAM 3LX, VAM 4C / VAM 4CD are equipped with one output trip relay.
- Indication of active sensor.
- Protection zone addresses (max. 4 zones)
- Detachable external wiring terminal blocks (does not apply to the current terminals of VAM 4C).
- Connection for a portable arc sensor (VAM 10L , 3LX and 3L)
- Free placement in the switchgear.
- Intra-unit cabling with factory-made modular cable or instrumentation cable.

1.1.3. Arc sensors VA 1 DA, VA 1 EH, ARC SLx, ARC SLm-x and VA 1 DP

Sensors placed in the switchgear transfer the light information to the I/O units.

Arc sensor VA 1 DA

Figure 1.1.3-1 Arc sensor VA 1 DA

- Strong light is transformed to a current signal in the sensor
- VAM 10L transfers the current signal to the central unit
- Standard cable lengths 6 m and 20 m
- The sensor type offers a cost-effective arc protection solution
- Easy to install and repair (after arc faults, for example)
- Normal installation involves one sensor in each switchgear compartment
- Self-supervised arc sensor

Arc sensor VA 1 EH

Figure 1.1.3-2 Arc sensor VA 1 EH

- Strong light is transformed to a current signal in the sensor
- VAM 10L transfers the current signal to the central unit
- Standard cable lengths 6 m and 20 m
- The sensor type offers a cost-effective arc protection solution
- The sensor can be installed in a tube, for example, so that the active light detector sees the monitored zone.
- Self-supervised arc sensor

Arc fibre sensor ARC SLm-x

Figure 1.1.3-3 Arc fibre sensor ARC SLm-x

- The fibre sensor is a durable glass fibre, which is manufactured in lengths of 10, 15, 20, 25, 30, 35, 40, 50 and 70 metres
- The detected light information is transferred to the VAM 3L /VAM 3LX unit inside the fibre
- The fibre will be installed to go through the supervised compartments
- Monitoring the light information with a fibre system is a cost-effective solution e.g. in low voltage switchgears with several compartments
- Self-supervised arc sensor
- More than 8,000 lux

Portable arc sensor VA 1 DP

Figure 1.1.3-4 Portable arc sensor VA 1 DP

- Improves personal safety when working with live voltage switchgear.
- The sensor is to be connected to the nearest light I/O unit (VAM 10L, VAM 3L or VAM 3LX) using a snap-in connector
- Cable length 5 metres
- The sensor is designed to be attached e.g. to the edge of a pocket in the technician’s working wear

1.1.4. Other system components

Modular cable VX001

Figure 1.1.4-1 Modular cable VX001

The I/O and master units are to be connected to each other using a modular cable approved by the manufacturer. The cable is equipped with quick- disconnect connectors.

Modular cables are available in lengths of 1, 3, 5, 7, 10, 15, 20, 25, 30 metres.

NOTE! The total length of the modular or instrumentation cables of the system, measured from the central unit to the furthest I/O unit, may not exceed 100 metres.

1.2. Operational safety

Dangerous voltages may occur at the terminal in the back panel of the central unit, even though the auxiliary power supply has been disconnected. Do not open the secondary circuit of a live current transformer. Disconnecting the secondary circuit of a live current transformer may cause dangerous overcurrents! Always observe all national and regional regulations and guidelines.

Read any instructions carefully before performing any operations.

2. User interface

The control and acknowledgement functions of the VAMP 221 arc protection system are mainly carried out using the push buttons on the central unit. Information on equipment status and operation can also be read on the central unit's display and indicator lights.

2.1. Front panel of the central unit VAMP 221

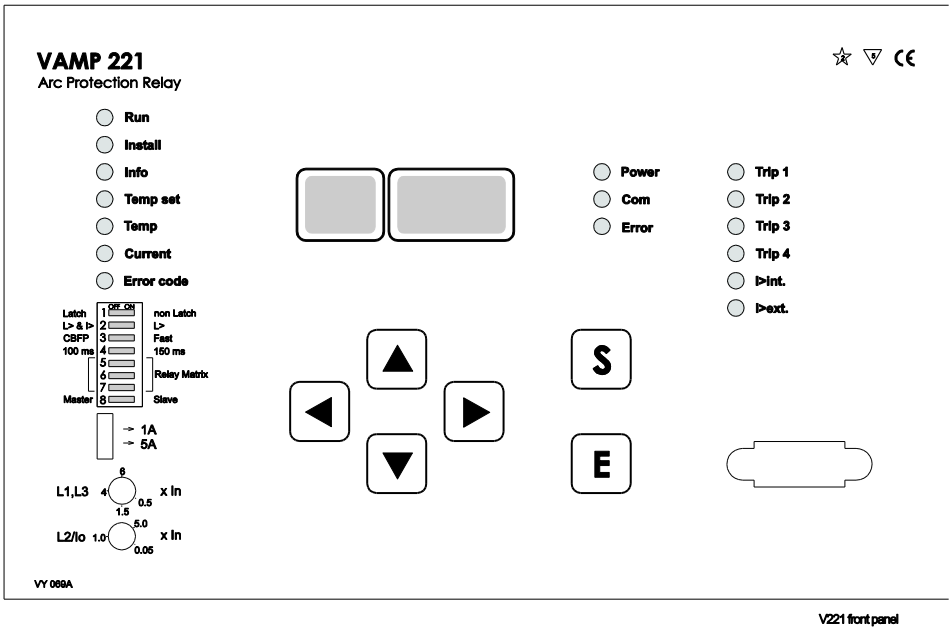


Figure 2.1-1 Central unit VAMP 221 - front panel

The front panel of the central unit contains all the programming and control buttons, and the DIP-switches that control the operation of the central unit.

2.1.1. Display and status indications

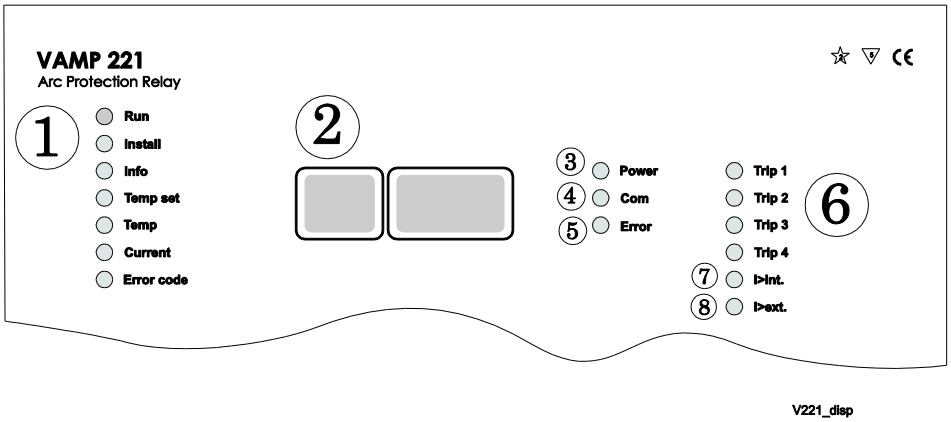


Figure 2.1.1-1 Central unit VAMP 221 - display and status indications

1. Operating status indication lights, see section 'Moving in menus'

RUN	normal operation
INSTALL	system configuration
INFO	system configuration check
TEMP SET	reserved for future use
TEMP	reserved for future use
CURRENT	current setting limit and measurement indication
ERROR	reading and resetting of fault memory

2. Display
3. POWER indicator light, indicates all supply voltages are in order.
4. COM indicator light, blinks in INSTALL mode when the central units and I/O units are communicating.
5. ERROR indicator light, indicates internal fault detected by the relay self-diagnostics.

NOTE! The light also blinks dimly in normal operating mode (visible only in the dark).

6. Trip indication lights, indicate which trip stages have been activated.
7. I>int LED light, indicates overcurrent activation of the central unit.
8. I>ext LED light, indicates overcurrent activation outside the central unit.

NOTE! Any rippling in the display is due to its refresh rate.

NOTE! Moving in the operating menus does not affect the operation of the arc protection; the system is ready to activate once the system has been configured and while the central unit is connected to an operating voltage.

2.1.2. Buttons and programming switches

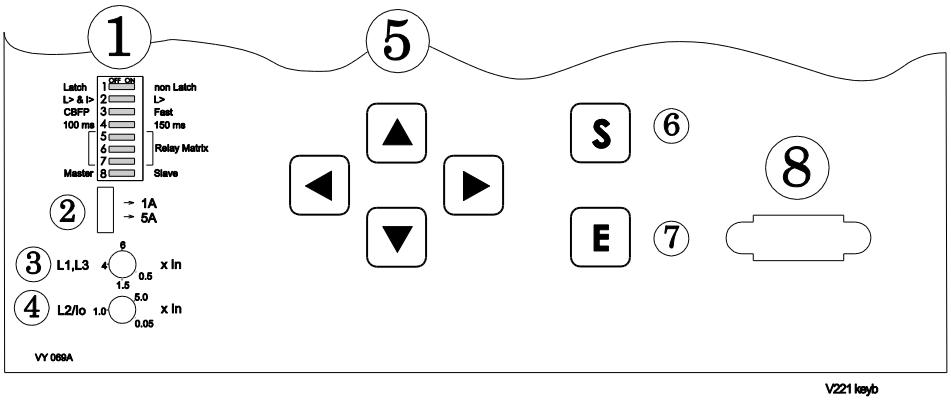


Figure 2.1.2-1 Buttons and programming switches

1. Programming switches for the trip relay matrix
2. Selection switch for the secondary current of the current transformer
3. Overcurrent setting knob (I_{L1}, I_{L3}), setting range 0.5…6xI_n
4. Overcurrent setting knob (I_{L2}, I_0), setting range 0.05…5xI_n
5. Navigation keys
6. SET push button for activating functions
7. ENTER push button for executing functions
8. Communication port for loading software updates, not needed in normal operation.

For more details on the trip relay matrix, see section 3.3 Using programming switches.

2.1.3. Moving in menus

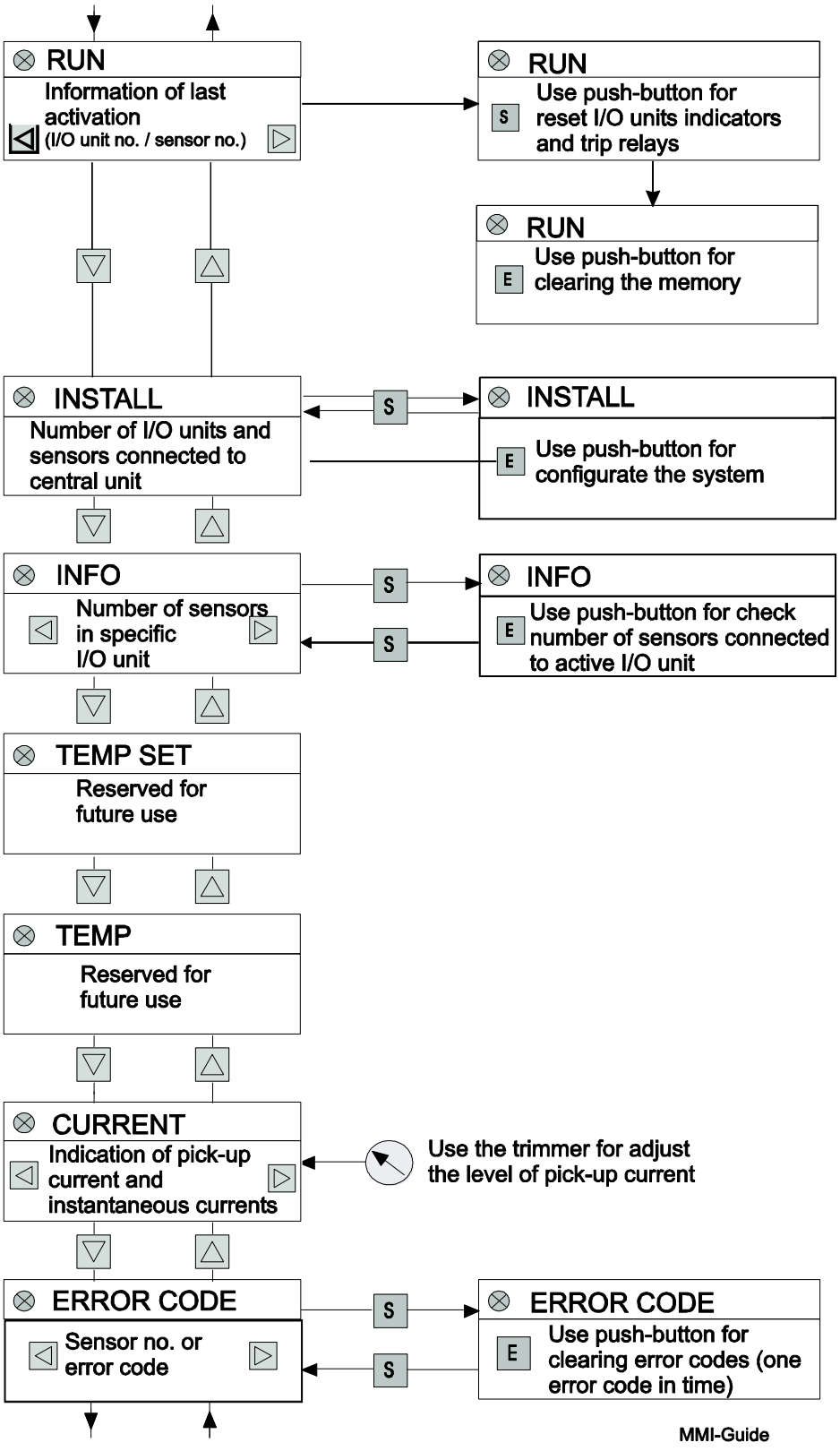


Figure 2.1.3-1 Moving in the mode menu

Select the operating status with the up and down navigation keys on the central unit.

To activate a function, use the S key. A blinking display indicates that the function has been activated. Press E to confirm the execution of an activated function. To cancel an activated function, press S again.

Use the left and right navigation keys to browse parallel information; for example, you can change the I/O unit you wish to view in the INFO mode or compare the current limit setting values the measured earth-fault and/or phase currents.

NOTE! If you do not touch the buttons for one minute, the central unit automatically returns to the normal operating mode (RUN). Regardless of which menu is displayed the arc system will always be ready to operate!

2.2. I/O unit

Usually, there is no need to touch the front panel during normal operation, since all the necessary information can be read from the central unit display. However, after a new installation or a system expand you will need to program certain functions (zone/address, trip output) in the I/O unit.

NOTE! If you unfasten the terminal blocks during installation, remember to tighten the fixing screws after installation! Also tighten the screws even if you did not unfasten the blocks.

2.2.1. VAM 12L

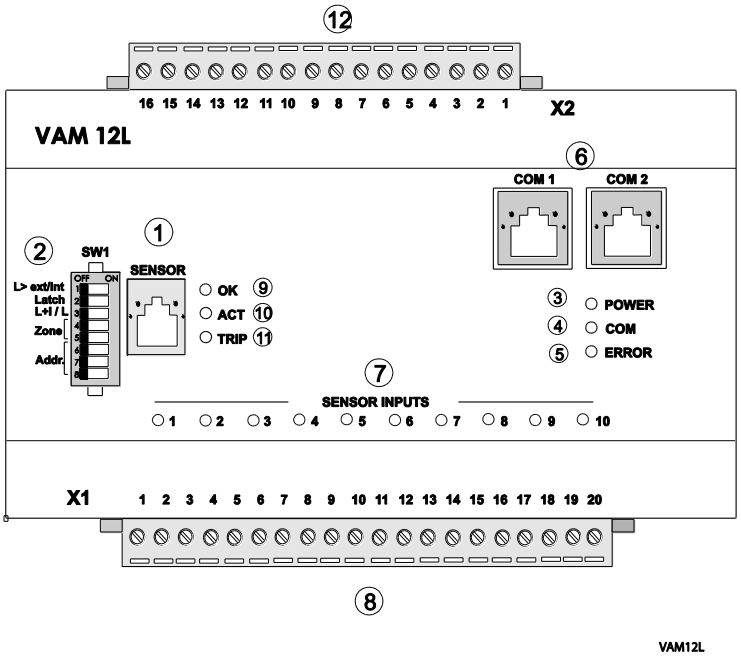


Figure 2.2.1-1 Arc sensor I/O unit 12L

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central unit and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relays activated
12. Terminal block for output relay

2.2.2. VAM 12LD

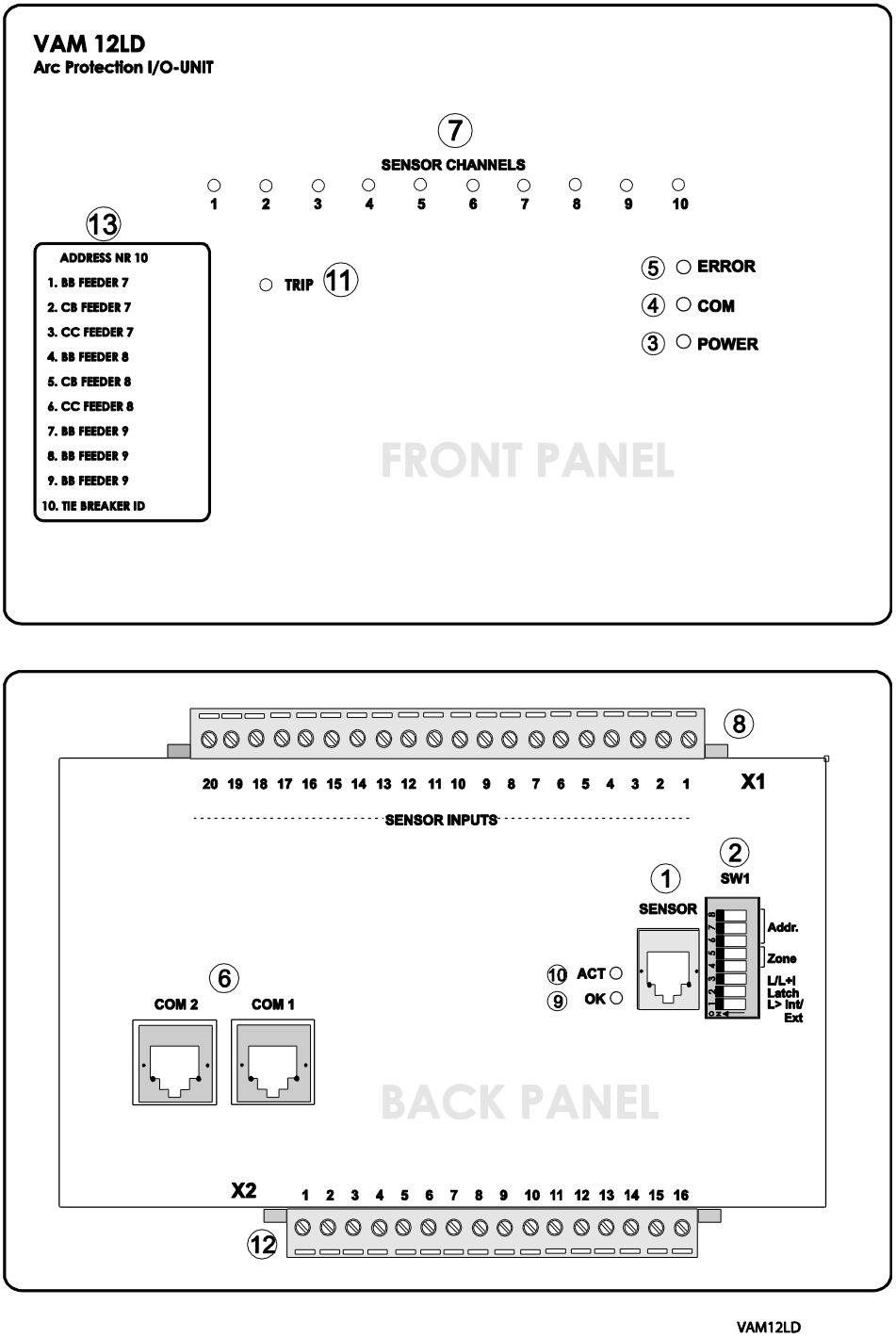


Figure 2.2.2-1 Arc sensor I/O unit VAM 12LD front and back panels

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central unit and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relays activated
12. Terminal block for output relays
13. Text pocket for sensor specific labels.

2.2.3. VAM 10L

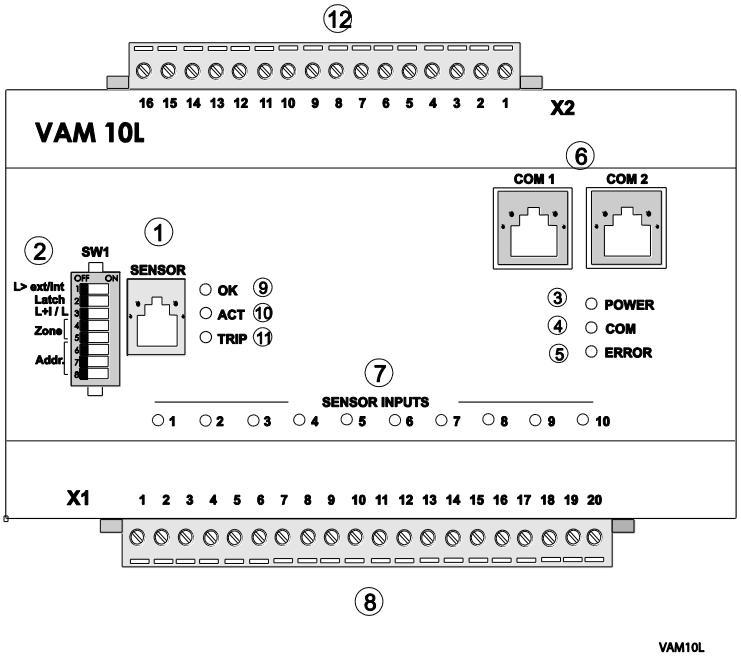


Figure 2.2.3-1 Arc sensor I/O unit VAM 10L front panel

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central unit and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal

2.2.4. VAM 10LD

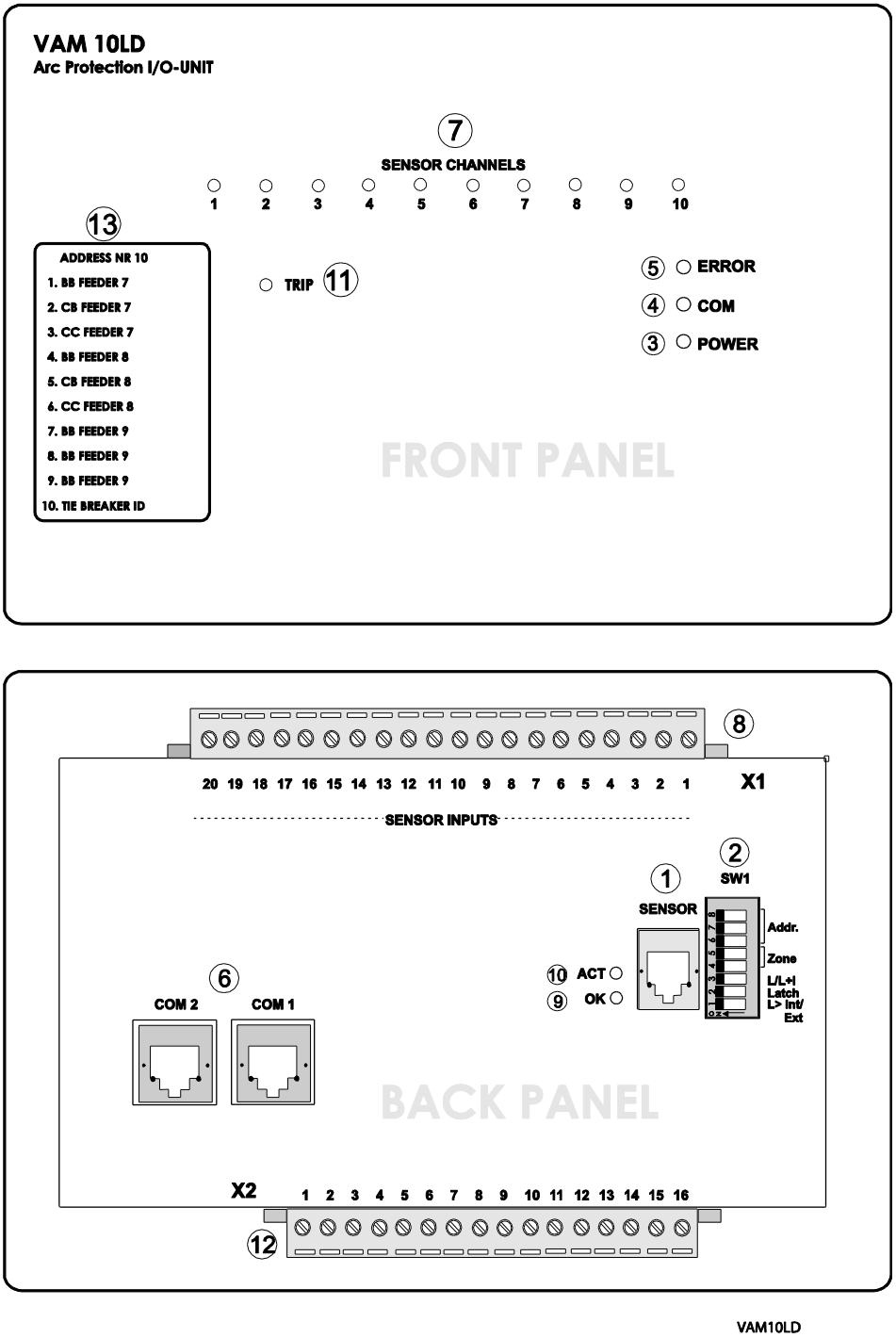


Figure 2.2.4-1 Arc sensor I/O unit VAMP 10LD front and back panels

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central unit and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
13. Text pocket for sensor specific labels.

2.2.5. VAM 3L

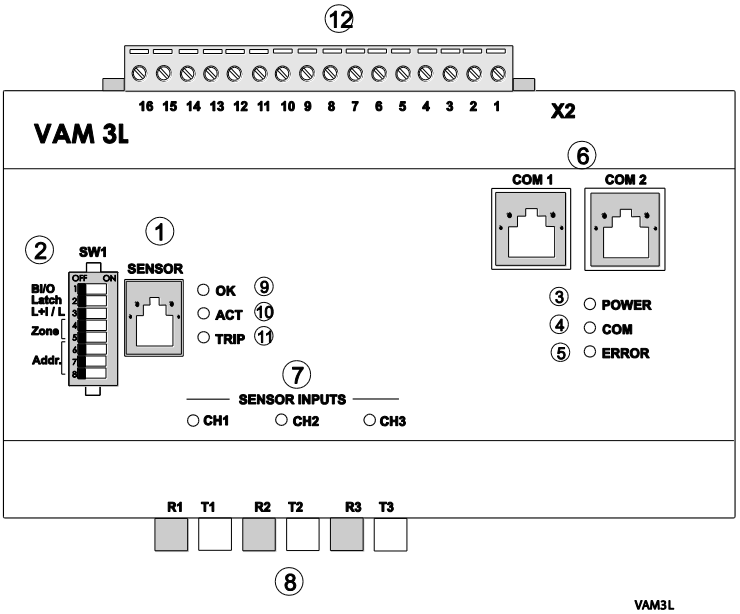


Figure 2.2.5-1 Arc fibre sensor I/O unit VAM 3L front panel

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central units and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminals for three fibre sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal

2.2.6. VAM 3LX

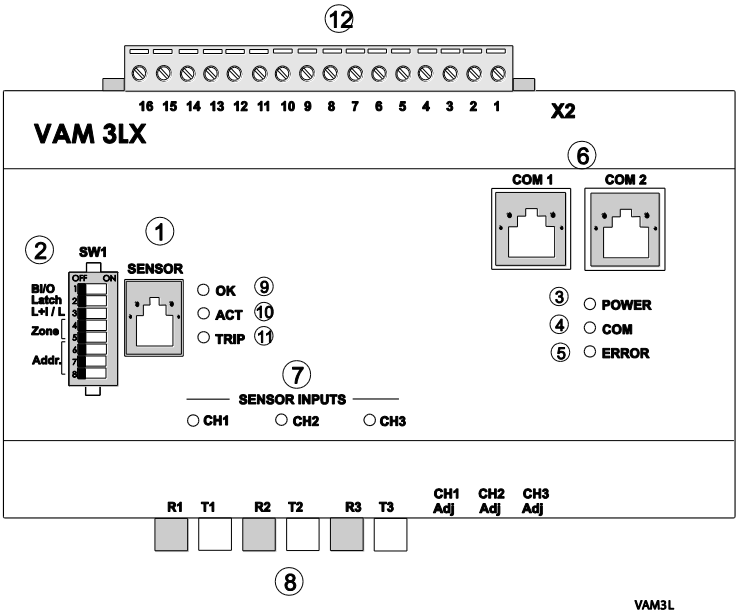


Figure 2.2.6-1 Arc fibre sensor I/O unit VAM 3LX front panel

1. Connection for portable arc sensor (VA 1 DP)
2. Programming switches
3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the central units and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the VX001 modular cables
7. LED lights indicating sensor activation
8. Terminals for three fibre sensors
9. Portable arc sensor VA 1 DP connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
13. Sensitivity adjustments for each fibre sensor channels

2.2.7. VAM 4C

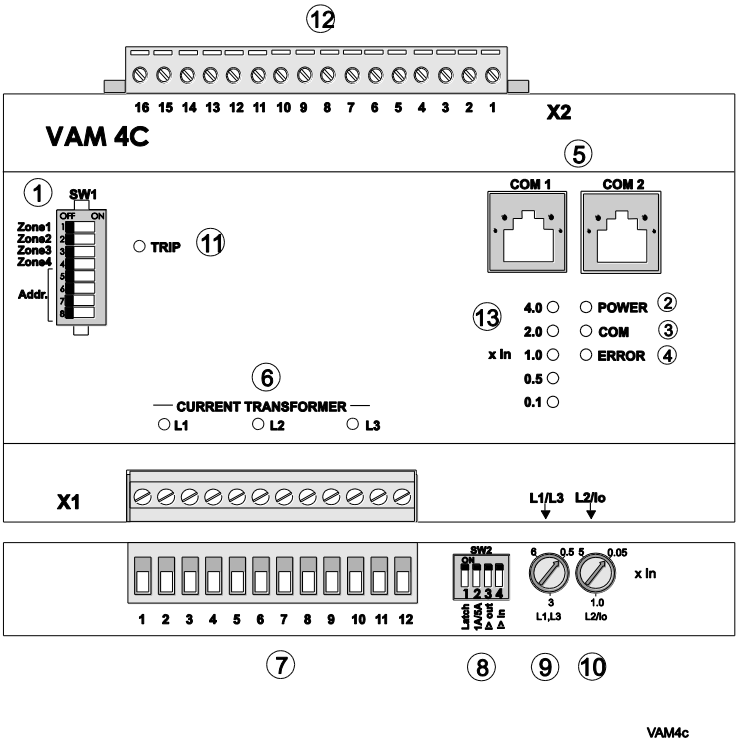


Figure 2.2.7-1 Current I/O unit VAM 4C front panel

1. Programming switches
2. POWER indicator light, indicates the supply voltages of each component are in order.
3. COM indicator light, lit when the central units and I/O units are communicating.
4. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty current transformer or phase current unbalance.
5. Connector sockets for the VX001 modular cables
6. LED lights indicating that I> stage has started
7. Terminals for three current transformers
8. Current transformer programming switches
9. Overcurrent setting knob (I_{L1}, I_{L3}), setting range 0.5…6xI_n
10. Overcurrent setting knob (I_{L1}, I_0), setting range 0.05…5xI_n
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
13. Indicator leds for current setting

2.2.8. VAM 4CD

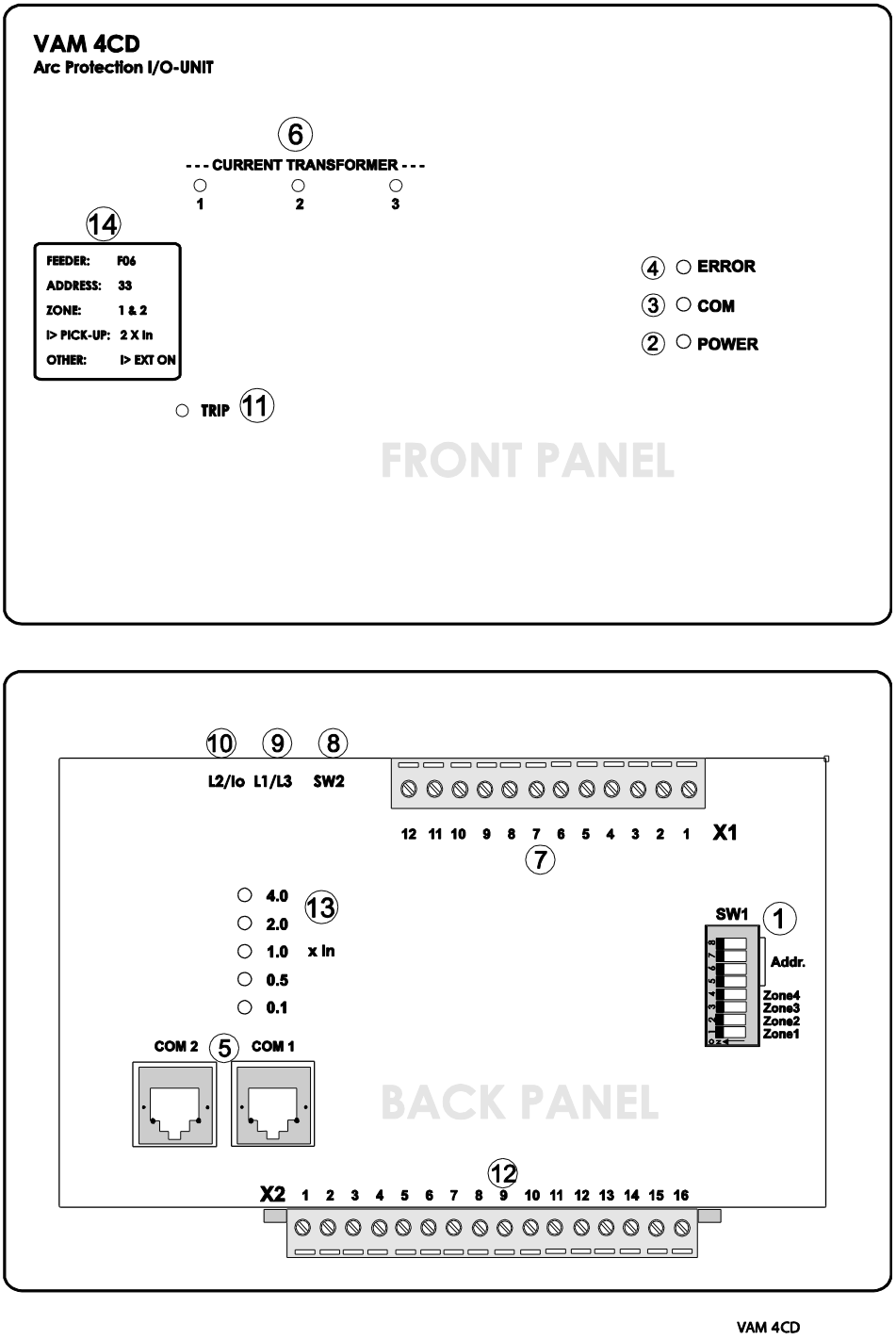


Figure 2.2.8-1 Current I/O unit VAM 4CD front and back panel

1. Programming switches
2. POWER indicator light, indicates the supply voltages of each component are in order.
3. COM indicator light, lit when the central units and I/O units are communicating.
4. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty current transformer or phase current unbalance.
5. Connector sockets for the VX001 modular cables
6. LED lights indicating that I> stage has started
7. Terminals for three current transformers
8. Current transformer programming switches
9. Overcurrent setting knob (I_{L1}, I_{L3}), setting range 0.5…6xI_n
10. Overcurrent setting knob (I_{L1}, I_0), setting range 0.05…5xI_n
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
13. Indicator leds for current setting
14. Text pocket

2.2.9. Multiplying relay VAR 4CE – front plate

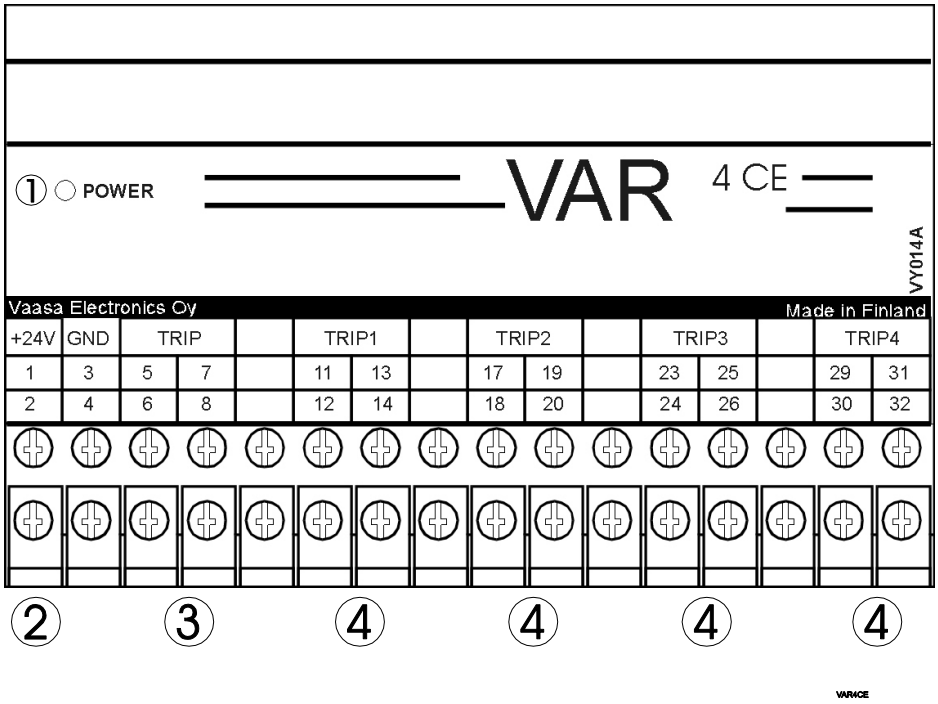


Figure 2.2.9-1 Multiplying relay VAR 4CE

1. POWER LED, indicates that the external operating voltage of +24 Vdc is connected.
2. Terminals for external operating voltage (+24 Vdc). Can be supplied by central units or I/O units.
3. Terminals for incoming trip signal (external dry contact).
4. Terminals for outgoing trip signals (four potential-free contacts, normally open).

2.2.10. Multiplying relay VAMP 4R - front plate

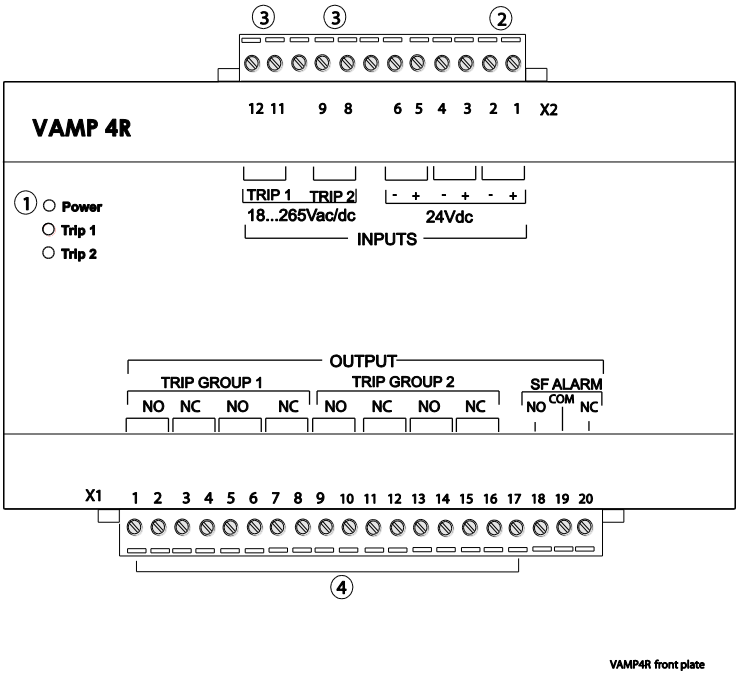

③ ③ ②
12 11 9 8 6 5 4 3 2 1 X2
VAMP 4R
① Power
Trip 1
Trip 2
TRIP 1 TRIP 2
18...265Vac/dc
- + - + - +
24Vdc
INPUTS
OUTPUT
TRIP GROUP 1
TRIP GROUP 2
SF ALARM
NO NC NO NC NO NC NO NC NO COM NC
X1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
④
VAMP4R front plate

Figure 2.2.10-1 Multiplying relay VAMP 4R

1. POWER LED, indicates that the external operating voltage of +24 Vdc is connected.
2. Terminals for external operating voltage (+24 Vdc). Can be supplied by central units or I/O units.
3. Terminals for incoming trip signal (e.g. 24 Vdc from VAM I/O unit binary output, 2 groups). Control voltage range is 18 … 265 Vad/dc.
4. Terminals for outgoing trip signals (8 potential-free contacts, 4 normally open, 4 normally closed).

3. VAMP 221 arc protection system operation and troubleshooting

Under normal conditions the arc protection system requires very little attention. The only servicing measures required in field conditions are scheduled operational tests, the intervals and scope of which depends on local legislation.

3.1. System status indications

The arc protection system has an extensive indication for different operation modes e.g. sensor activated, overcurrent activated, arc protection tripped, and disturbance. System configuration and measurements can also be checked during operation.

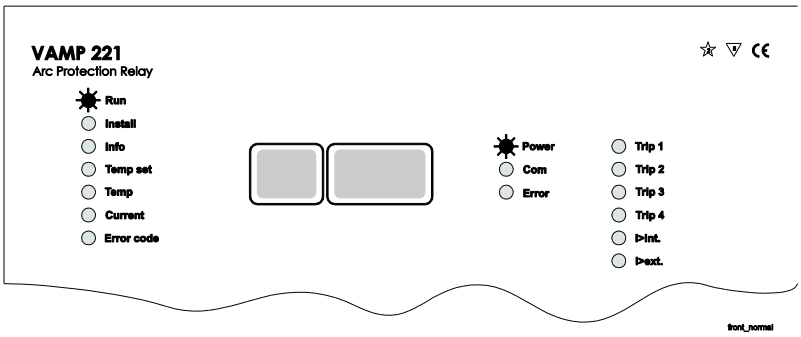


Figure 3.1-1 VAMP 221 in normal mode

In normal mode, only the RUN and POWER indicator lights are lit continuously. The COM indicator light blinks occasionally, indicating communication between units and during installation. The POWER indicator lights of the I/O units must also be permanently lit and the COM indicator light blink during communication.

3.1.1. Arc fault

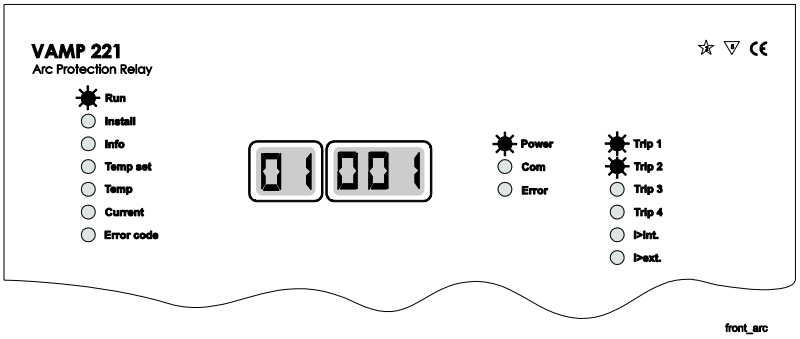


Figure 3.1.1-1 VAMP 221 has tripped due to arc fault, light indication I/O unit 1 sensor 1

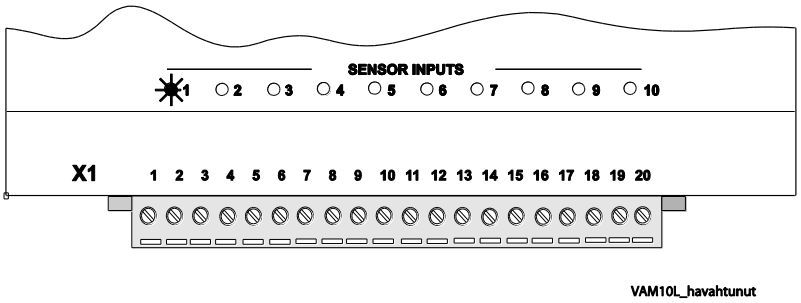


Figure 3.1.1-2 VAM 10L indicates light on channel 1

When the arc protection activates due to arc fault, the alarm relay activates and the trip indicator lights indicate the activated output trip relays.

The display at the central unit shows which arc sensor first gave the light information. This sensor information is only visible in the RUN mode. If several sensors were activated during the fault, the other activated sensors can be identified from the arc sensor leds (I/O units' indicator lights). The address of an activated sensor is stored in the fault memory, even if activation did not lead to tripping. See Figure 3.1.1-2. When the light information is transferred via the BI/O bus, the source of the light information is not visible on the display and the source must be located using other VAMP protection relays connected with the BI/O bus.

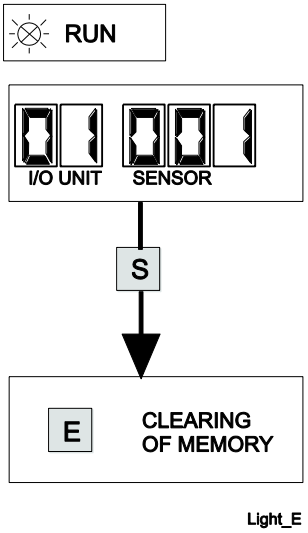


Figure 3.1.1-3 Reading and resetting the arc fault memory

To reset the arc fault memory, do the following:

- Press the S button to activate the RUN mode.
- When the sensor address blinks on the display, press the E button.

The fault memory resets automatically two hours after activation.

3.1.2. Overcurrent alarm

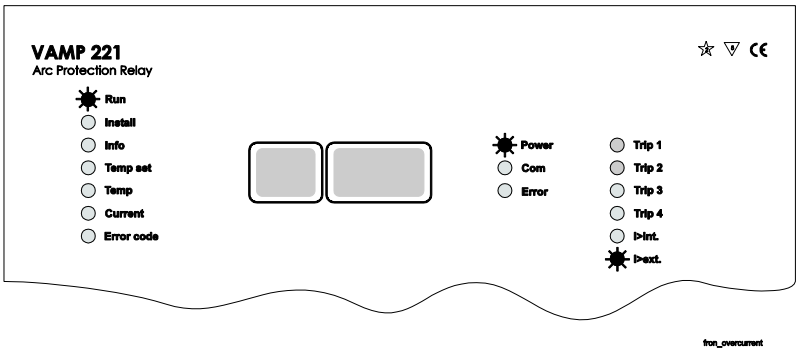


Figure 3.1.2-1 VAMP 221 activated due to overcurrent

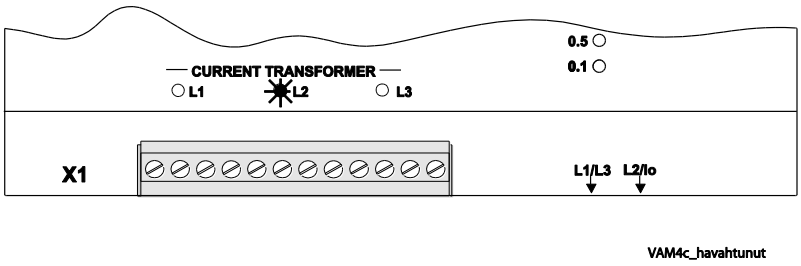


Figure 3.1.2-2 VAM 4C indicates overcurrent on channel L2

When any component of the current measuring system detects a current exceeding the setting value of the unit, it sends current information to all other units. The I>int indicator light is lit when the central unit measures the overcurrent. If the current information is obtained from outside the central unit (either through the BI/O bus or from a current I/O unit), the I>ext LED indicator light is lit. The indicator light of the activated stage is lit in the current I/O unit (VAM 4C).

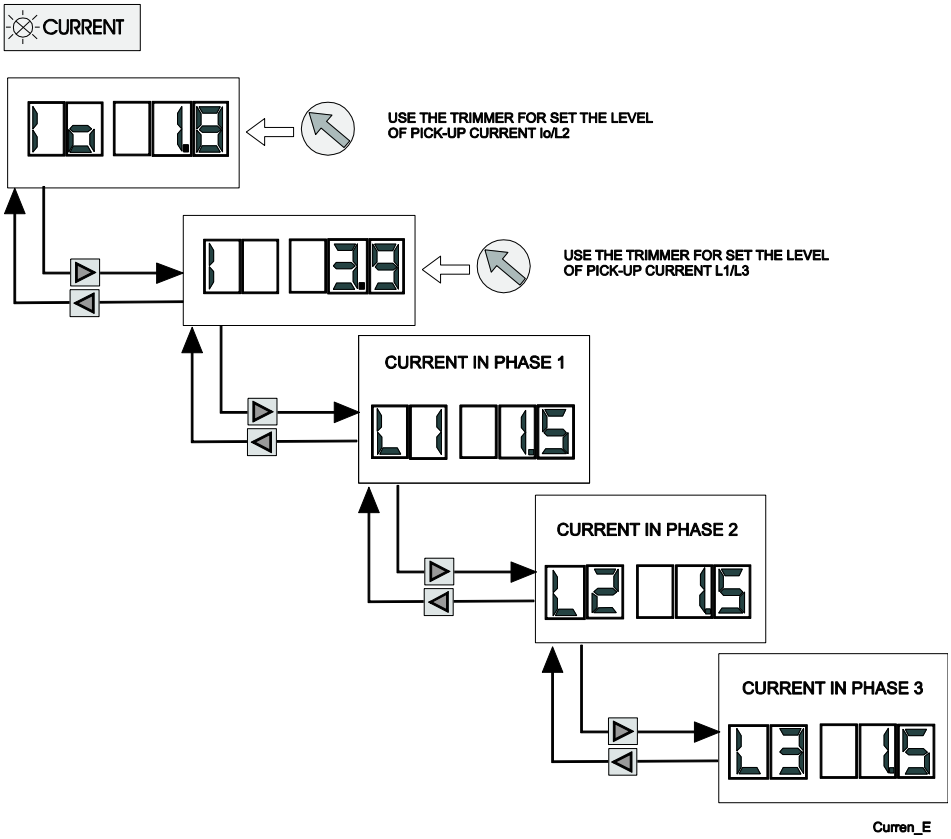

CURRENT
USE THE TRIMMER FOR SET THE LEVEL OF PICK-UP CURRENT Io/L2
USE THE TRIMMER FOR SET THE LEVEL OF PICK-UP CURRENT L1/L3
CURRENT IN PHASE 1
CURRENT IN PHASE 2
CURRENT IN PHASE 3
Curren_E

Figure 3.1.2-2 Reading measured currents in the CURRENT mode

To read the current values measured by the central unit, do the following:

- Select the CURRENT mode using the up and down arrow keys.
- The earth fault current/phase 2 current setting value appears on the screen (I_0).
- Press the right arrow key to view the phase current setting value and instantaneous values measured in the current measuring channels.

3.1.3. Self-supervision alarm

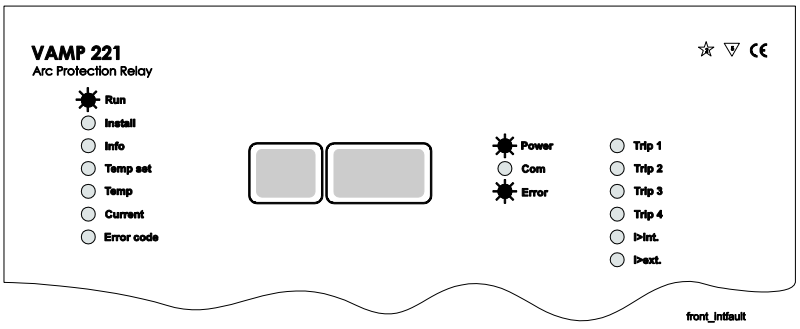


Figure 3.1.3-1 VAMP 221 has detected an internal fault

The system's self-supervision function continuously monitors the operation of the arc protection system. The self-supervision

function supervises all the components and cables of the system. When self-supervision detects an internal fault, it activates the SF alarm relay in the central unit and lights the ERROR indicator led.

Self-supervision generates a fault code for the detected fault, which is stored in the fault memory of the central unit. The fault memory may contain up to three faults (latest faults).

Fault codes can be red only in ERROR CODE mode.

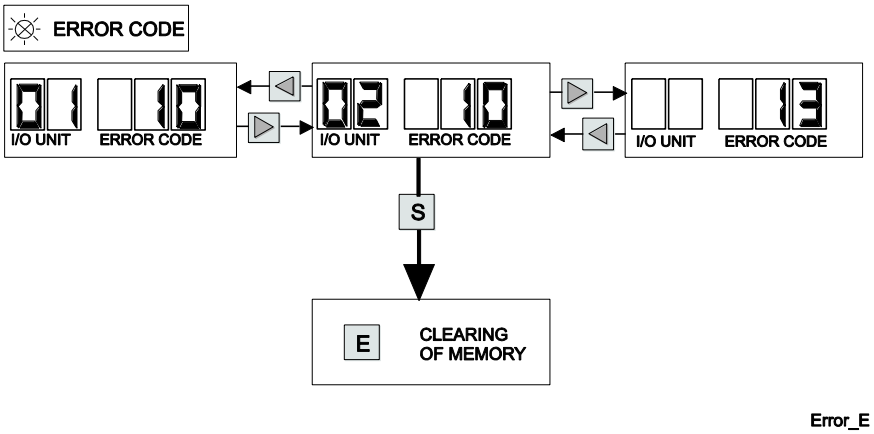


Figure 3.1.3-2 Reading and resetting the fault memory

To reset the arc fault memory, do the following:

- Press the S button to activate the ERROR CODE mode. The fault code starts blinking.
- Press the E button to erase the latest fault code from the memory. The next fault code, if any, appears on the screen.
- Once you have acknowledged each fault code separately, the display becomes dark in the ERROR CODE mode.

NOTE! If the fault that caused the fault code disappears by itself, the fault code in the fault memory is also erased automatically two hours after the disappearance of the fault.

3.1.4. Fault codes

The following table lists the fault codes and gives a brief description of each fault. A more detailed description of the fault and advice on how to locate the faulty component will be given below.

Fault code	Fault type	Cause
10	System configuration fault	Number of sensors changed
11	Damaged I/O unit	Faulty I/O unit in the system

12	Long BI/O bus activation	Faulty arc sensor or too low setting in the current I/O unit
13	Communication fault	Faulty communication channel
14	BI/O channel fault	Communication between two central units interrupted
01 18 02 18 03 18	Current measuring unbalance	Significant deviation detected during current measuring between different phases First two digits (01,02 or 03) indicate unbalanced phase. For example, fault code “03 18” indicates unbalanced in phase three.

NOTE! Unbalance error has been removed from the software version 3.12 onwards.

Table 3.1.4-1 Self-supervision fault codes

System configuration fault (fault code 10)

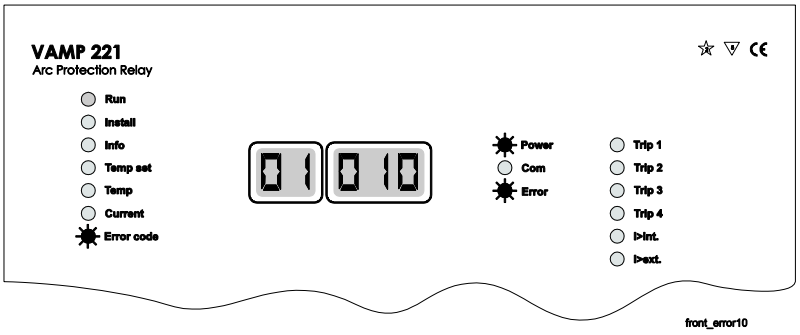


Figure 3.1.4-1 The system indicates a configuration fault in the I/O unit whose address is 01

This fault code indicates a change in system configuration.

Potential causes:

1. Sensors have been added to the system after system implementation.

   Corrective measures:

   - Check the sensor connections of the I/O unit indicated by the fault code and the programmed configuration in the INFO mode (see Chapter 3.4.1).
   - If the number of sensors in the I/O unit is higher than the number given by the central unit, re-configure the system (see Chapter 3.4).

2. A sensor connected to the system or its wiring is faulty.

   Corrective measures:

   - Check the configuration in the INFO mode (see Chapter 3.4.1)
   - If the number of sensors in the unit is lower than the number given by the central unit, check the unit wiring visually and tighten the connections.
   - Configure the system (see Chapter 3.4)
   - If the system still cannot find all the sensors, disconnect the sensor wires one at a time and configure the system after each disconnection.
   - Once you have identified the faulty sensor, check the wiring and replace the sensor, if necessary.

NOTE! The current I/O unit normally indicates three sensors, even if the number of current transformers connected is only one or two.

Damaged I/O unit (fault code 11)

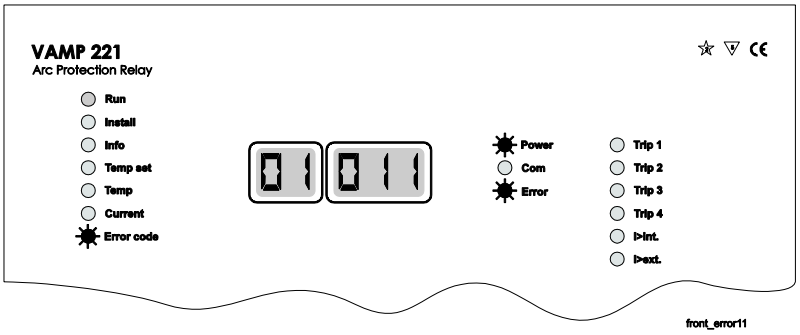


Figure 3.1.4-2 The system indicates a fault in the I/O unit whose address is 01

This fault code indicates a damaged I/O unit.

NOTE! While this fault is activated, no sensor activation connected to the faulty unit will be transferred to the central unit.

Potential causes:

1. A sensor connected to the unit has remained activated for longer than three seconds.

   Corrective measures:

   - Check the physical location of the activated sensor.
   - Strong, direct light may activate the sensor
   - If the arc sensor is not exposed to direct light, remove one of the sensor conductors to check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably damaged. In this case, replace the faulty sensor.
   - In the overcurrent unit, check the range of the overcurrent setting and whether the nominal values of the current transformers' secondary circuits are compatible.

2. The modular cable connecting the units is loose or faulty.

   Corrective measures:

   - Check the connection and status of the modular cable connected to the I/O unit indicated in the fault code.

3. The I/O unit has no supply voltage.

   Corrective measures:

   - Check whether the POWER indicator light of the I/O unit is lit.
   - If the light is not lit, measure if the I/O received a supply voltage of 24 Vdc (X2-1 +24 Vdc, X2-2 GND). If the voltage supply is in order but the light is not lit, replace the faulty I/O unit.
   - If there is no voltage supply, find out whether it should be supplied from the central unit or an external voltage supply. Check the voltage of the external voltage supply, if any.
   - If the voltage is supplied by the central unit, measure its 24 Vdc supply voltage (X3-2 +24 Vdc, X3-1 GND). If there is no voltage, replace the central unit.

4. The I/O unit is faulty.

   Corrective measures:

   - If the TEST/ERROR indication light is permanently lit and no sensor is activated, either the modular cable (see above) or the I/O unit is faulty. In this case the I/O unit must be replaced.

Too long BI/O bus activation (fault code 12)

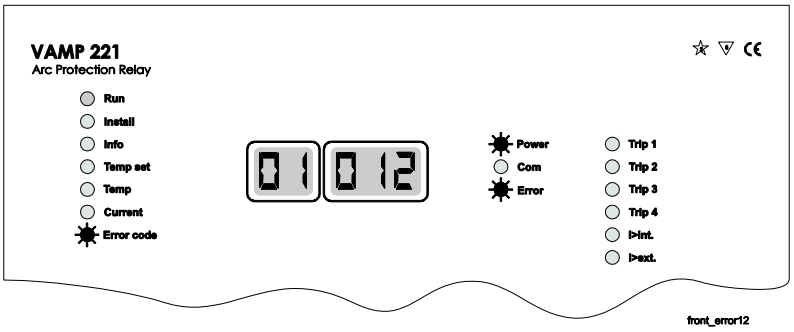


Figure 3.1.4-3 The system indicates that the BI/O bus has remained activated for longer than three seconds

This fault code indicates that the system's BI/O bus has remained activated for too long for normal operation.

Potential causes:

1. A sensor connected to the unit via the BI/O bus has remained activated for longer than three seconds.

   Corrective measures:

   - Check the physical location of the activated sensor.
   - Strong direct light may activate the sensor
   - If the arc sensor is not exposed to direct light, remove one of the sensor conductors to check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably faulty. In this case, replace the faulty sensor.
   - In the overcurrent unit, check the range of the overcurrent setting and whether the nominal values of the current transformers' secondary circuits are compatible.

Communication fault (fault code13)

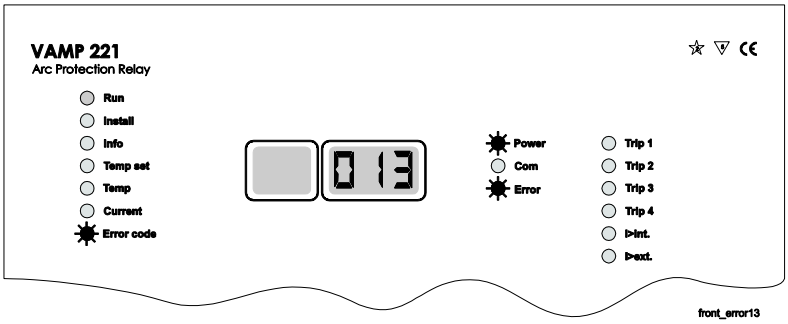


Figure 3.1.4-4 The system indicates a disturbance in the communication between units.

This fault code indicates faulty operation of the system's communication bus.

Potential causes:

1. The modular cable between units or external wiring has become disconnected or faulty.

BI/O channel fault (fault code 14)

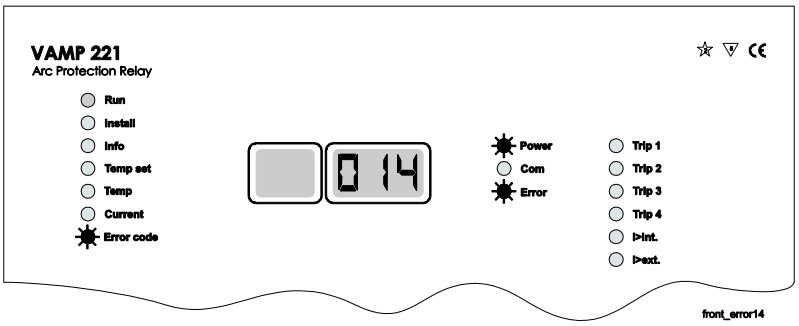


Figure 3.1.4-5 The system indicates a disturbance in the communication between two central units connected via a BI/O bus.

This fault code indicates a fault in the system's BI/O bus.

Potential causes:

1. Fault in the BI/O system cable

   Corrective measures:

   - Check the cable. If necessary, repair or replace the cable.

2. The central unit connected to the BI/O is faulty.

   Corrective measures:

   - Check the central units. If necessary, replace a central unit.

Unbalance fault (fault code18)

NOTE! Unbalance error has been removed from the software version 3.12 onwards.

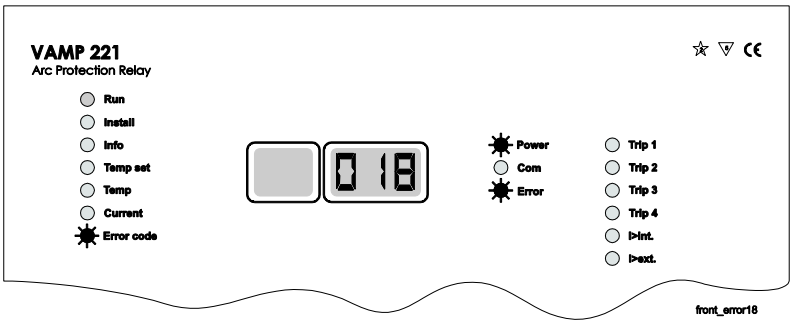


Figure 3.1.4-6 The system indicates that the current measuring unit has detected significant unbalance between the measuring channels.

This fault code indicates that the measuring channels of the current measuring unit connected to the system have detected significant unbalance between the different measuring channels. If the channel I_{L2}/I_0 of the current measuring unit is used to measure phase current, the I_{L2}/I_0 settings must be the same as for I_{L1}/I_{L3}. In this case the I_{L2}/I_0 channel is also covered by the unbalance alarm; otherwise, the system only compares the unbalance between two phase currents.

The factory setting for unbalance is 20% of the measured currents. The alarm does not function with currents below 5 %*I_n, which effectively prevents false alarms.

Potential causes:

1. The current transformers connected to the current channels have different transformation ratios.

   Corrective measures:

   - Check the transformation ratios. The zero current measurement is normally connected to the I_{L2}/I_0 channel. This makes it possible to set different values to the channels.
   - Connect similar current transformers to the I_{L1} and I_{L3} channels.

2. The secondary circuit of the current transformers is short-circuited.

   Corrective measures:

   - With a clip-on ammeter, check whether the measuring current travels through the current measuring unit.
   - Check which other components are connected to the current circuit and whether the current travels through them,

- Once you have found the short circuit, check the status of the current circuit before removing the short circuit.

3. The current measuring channel is faulty.

   Corrective measures:

   - With a clip-on ammeter, check whether the measuring current travels through the current measuring unit.
   - If the current travels through the unit but the device does not measure any current, the central unit must be replaced.

NOTE! Do not open a loaded current measuring circuit before you have reliably short-circuited the secondary circuit of the current transformer. **An open secondary circuit in the current transformer may destroy the current transformer!**

3.2. Using programming switches

Before system implementation, check the positions of the programming switches in accordance with the following basic principles:

- Each I/O unit connected to the communication bus has its own address (each I/O unit have an unique address).
- Set the programming switches before connecting the supply voltage.
- If you have to change the switch positions once the supply voltage has been connected, disconnect the supply voltage to the unit in question for the duration of the programming and re-configure the system.

3.2.1. Central unit's programming switches

The central unit's programming switches mainly affect the operation of the central unit's trip relays.

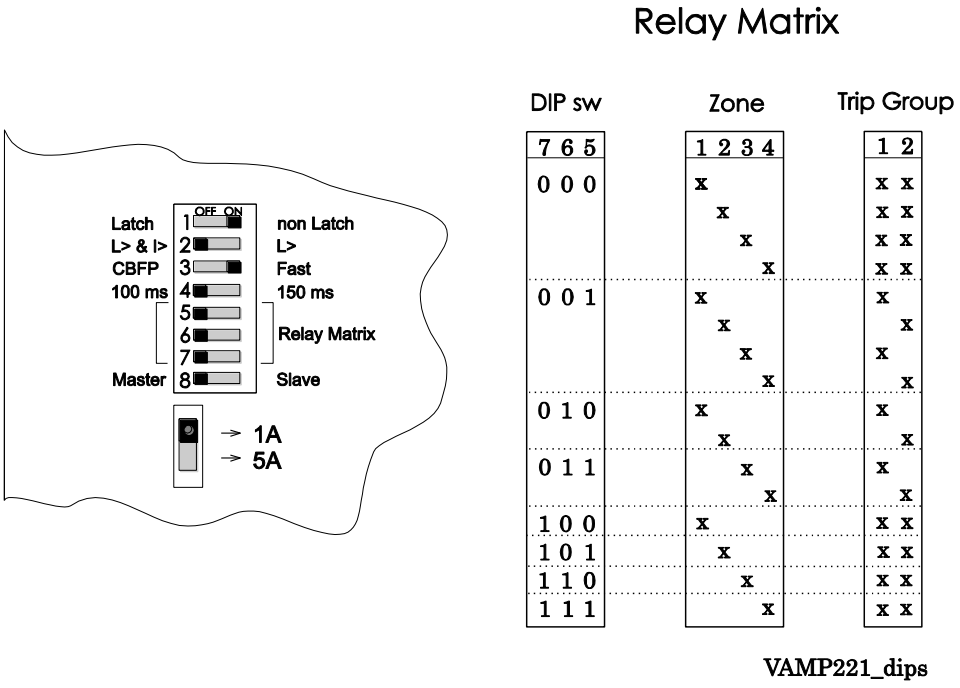


Figure 3.2.1-1 Programming switches in the front plate of the central unit

Switch 1 determines trip relay latch. When the switch is in the OFF position the trip relays remain engaged after the arc trip until the fault is acknowledged at the central unit's panel (see 3.1.1). In the ON position the trip relays follow the arc fault.

Switch 2 determines the arc trip criteria. When the switch is in the ON position the trip is based on light information only; in the OFF

position both fault currents exceeding the current limit and light information are required.
Switch 3 determines the operating speed of the second trip relay (TRIP 2 and 4) of each tripping group. When the switch position is OFF, the trip relays act as CBFP as follows: TRIP 2 acts as CBFP if central unit measures overcurrent and any of the light zones are activated. TRIP 4 acts as CBFP if overcurrent information comes from other device and any of the light zones are activated. Tripping delay time either 100 ms or 150 ms. In the ON position the trip relays serve as fast relays (delay time 7 ms).

Switch 4 determines the CBFP operating speed. When the switch is in the ON position the trip delay time is 150 ms, and in the OFF position 100 ms.

Switches 5, 6 and 7 determine the relay connection matrix. In the matrix the arc trips in different zones can be directed to two separate tripping groups (see Figure 3.2.1-1).

Switch 8 determines the mode of the central unit. When the switch is in the ON position the central unit operates in SUB-UNIT mode; in the OFF position the central unit serves as the central unit for the entire system.

NOTE! If several central units are connected to the same communication bus, only one unit may operate in CENTRAL UNIT mode.

3.2.2. Programming switches - I/O units

The programming switches of the I/O units are used to determine the unit address and trip relay function.

The system accommodates up to 16 I/O units. Eight addresses are reserved for each protection zone:

- **Zone 1** addresses 0…7
- **Zone 2** addresses 8…15
- **Zone 3** addresses 16…23
- **Zone 4** addresses 24…31

The programming switches have different weight factors. To create an address for the I/O unit, turn switches with different values to the ON position and calculate the sum of their weight factors. The following table shows the weight factors of each programming switch.

Switch No.	Weight factor
8	1
7	2
6	4
5	8
4 *)	16

*Table 3.2.2-1 Programming switch weight factors, *) VAM 12L / VAM 12LD, VAM 10L / VAM 10LD, VAM 3L and VAM 3LX only*

The address range for current I/O units is (32),33…46. Do not use address 32, because in this case the current I/O unit operates in CENTRAL UNIT mode and the actual central unit must be set to SUB-UNIT mode (see chapter 3.2.1). To determine the address of a current I/O unit, add the sum of the weight factors to 32 (for example, programming switch values total 7, address of the current I/O unit 32 + 7 = 39).

NOTE! Do not use 32 as the unit address if system have central unit.

Other programming switches have different functions in different units, as described below.

Attention! Note the position of the VAM 12LD, VAM 10LD and VAM 4CD dip switches.

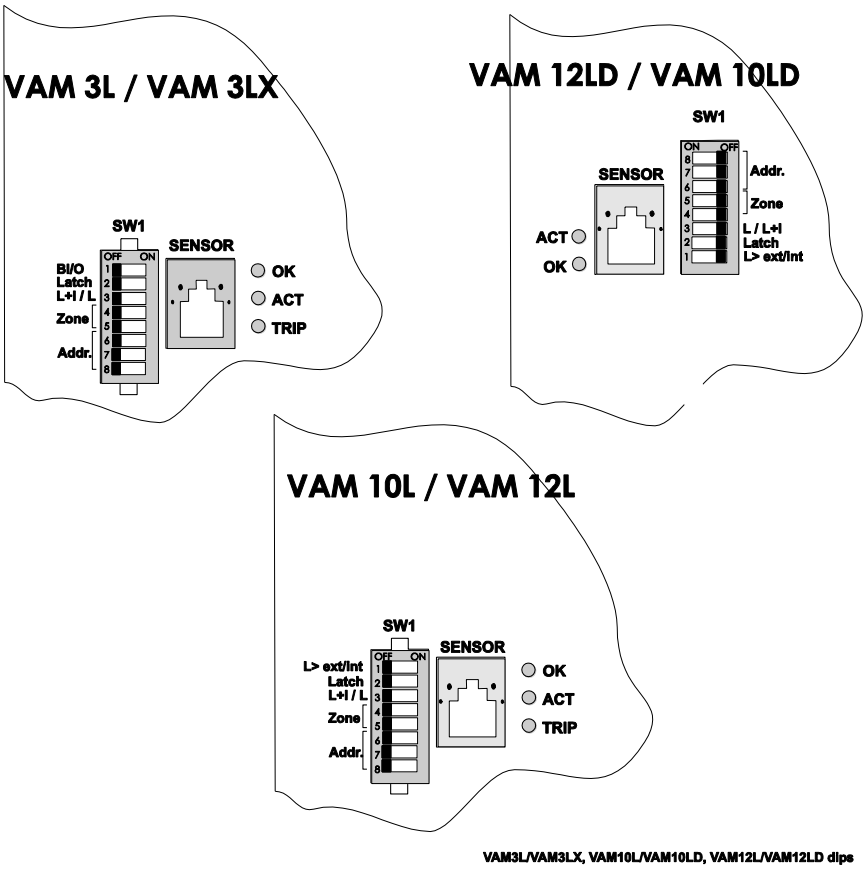


Figure 3.2.2-1 Programming switches for VAM 3L, VAM 3LX, VAM 10L, VAM 10LD, VAM 12L and VAM 12LD

VAM 10L / VAM 10LD, VAM 3L / VAM 3LX

Switch 1 determines which light activation activates the arc stage. When the switch position is ON, the arc stage only activates on the light information provided by the unit's own sensors. In OFF position the arc stage activates on the light information received from any unit in the same protection zone. (Please see Technical description part , Chapter 3.1. Application examples)

Switch 2 determines the trip relay latch. When the switch is in ON position the trip relay remains engaged after the arc trip until the fault is acknowledged at the central unit’s panel (see 3.1.1). In the OFF position the trip relay follows the arc fault.

Switch 3 determines the arc trip criteria. When the switch is in ON position the trip is based on light information only; in OFF position both fault currents exceeding the current limit and light information are required.

VAM 12L / VAM 12LD

When the switch is in “on” position (L>int), the output relays are only activated by dedicated sensors.

SENSOR 1 activates T1.

SENSOR 2 activates T2.

SENSOR 3 activates T3.

SENSOR 4 to 10 are normally sending out light information according to zone setting.

If the switch is in “off” position, all output relays are also controlled by the selected zone information. This activation source can be any sensor channel 4 to 10 or from an external I/O unit configured to the same zone.

VAM 4C / VAM 4CD

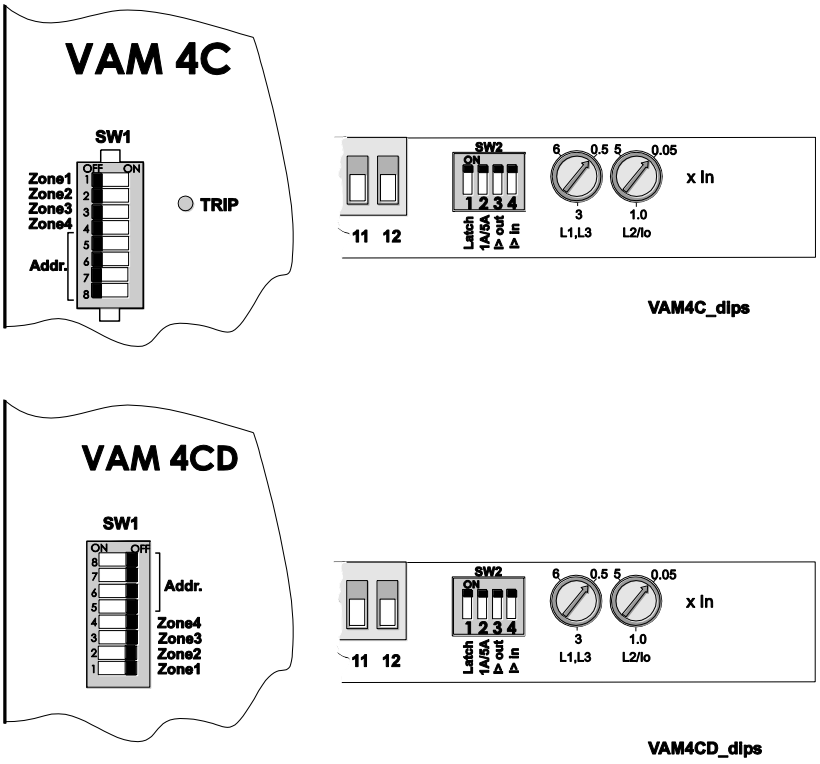


Figure 3.2.2-2 Programming switches of VAM 4C / VAM 4CD

SW NO:	Weight factor
8	1
7	2
6	4
5	8

Table 3.2.2-2 VAM4C dipswitches weight factors

SW1 switch settings

Switch	Definition	Description
1	Zone 1	System operating zone 1 (light information)
2	Zone 2	System operating zone 2 (light information)
3	Zone 3	System operating zone 3 (light information)
4	Zone 4	System operating zone 4 (light information)
5	Addr	Address weighting coefficient 8
6	Addr	Address weighting coefficient 4
7	Addr	Address weighting coefficient 2
8	Addr	Address weighting coefficient 1

SW2 switch settings

Switch	Definition	Description
1	Latch	Position ”0” (switch down): trip relay is only operational while the protection is activated Position ”1” (switch up): trip relay changes to latching status after trip
2	1A / 5A *	Position ”0” (switch down): rated secondary current of the current transformer is 1 A Position ”1” (switch up): rated secondary current of the current transformer is 5 A
3	I> out	Position ”0” (switch down): unit does not transmit the current criteria to other units Position ”1” (switch up): unit transmits the current criteria to other units
4	I> in	Position ”0” (switch down): unit does not receive the current criteria from other units Position ”1” (switch up): unit receives the current criteria from other units

*) As in CT

3.3. Adjusting the overcurrent setting

In the VAM 221 Arc Protection System all the overcurrent settings are expressed as multiples of the secondary rated current. For example, with a secondary selection of 5 A, the setting value 1.5 corresponds to a current of 7.5 A in the secondary circuit of the circuit breaker.

Adjusting the overcurrent setting is most convenient following the setting value in the CURRENT operating mode.

NOTE! The overcurrent settings will be changed regardless of the mode of the central unit. The new settings will be effective immediately. However, settings should be adjusted in CURRENT mode only, since the new setting value is visible immediately in this mode.

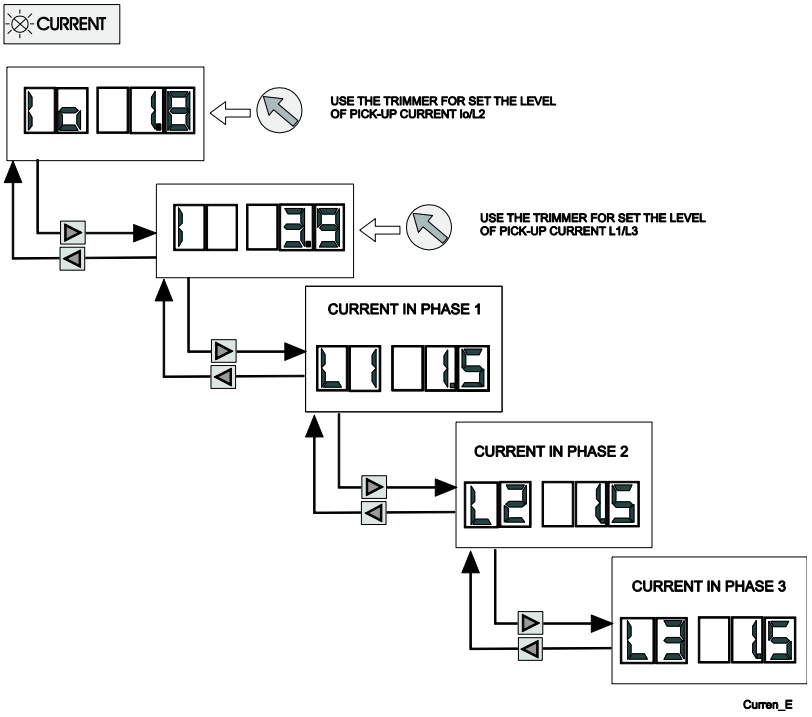

CURRENT
USE THE TRIMMER FOR SET THE LEVEL OF PICK-UP CURRENT Io/L2
USE THE TRIMMER FOR SET THE LEVEL OF PICK-UP CURRENT L1/L3
CURRENT IN PHASE 1
CURRENT IN PHASE 2
CURRENT IN PHASE 3
Curren_E

Figure 3.3-1 Adjusting overcurrent settings

- Select the secondary I_n of the CT using the selection switch.
- Select the CURRENT mode using the up and down arrow keys.
- The earth fault current/phase current L2 setting value appears on the screen. Adjust the L2/I_0 setting value (0.05…5.0*I_n) from the potentiometer.
- Press the right arrow key to view the current phase setting value. Adjust the L1/I_0 setting value (0.5…6.0*I_n) using the potentiometer.

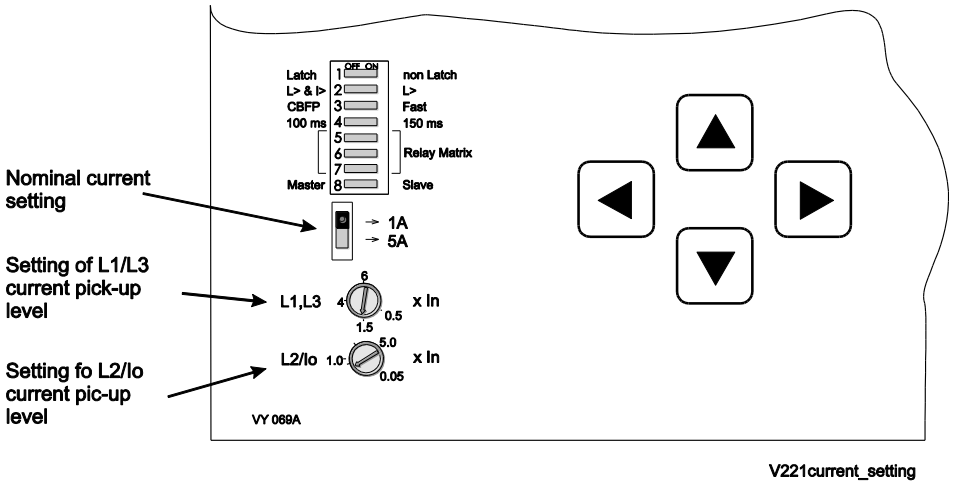


Figure 3.3-2 Adjusting the current setting in the central unit

The principles for changing the current setting in VAM 4C units are the same as for the central unit. You can see the estimated current setting from the led bar on the right side of the unit.

The most accurate way of setting the current limit for the unit is as follows:

- Turn the potentiometer to the maximum value.
- Feed a test current corresponding to the required setting using a testing device.
- Lower the setting until the current activation indicator led of the I/O unit and the I>ext indicator led in the central unit are lit.

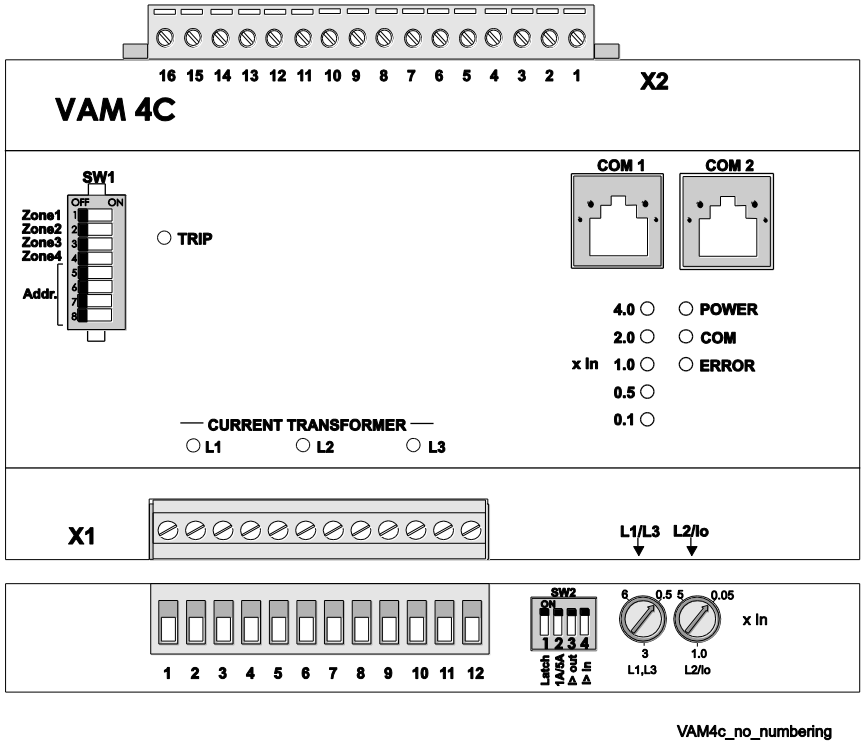


Figure 3.3-3 Adjusting the current setting in VAM 4C

3.4. Configuration of the arc protection system

Before system configuration, check the following:

- Have all the system sensors been connected to the I/O units?
- Have all the modular cables between I/O units been connected?
- Have all the I/O units been assigned individual addresses **before the supply voltage is connected?**

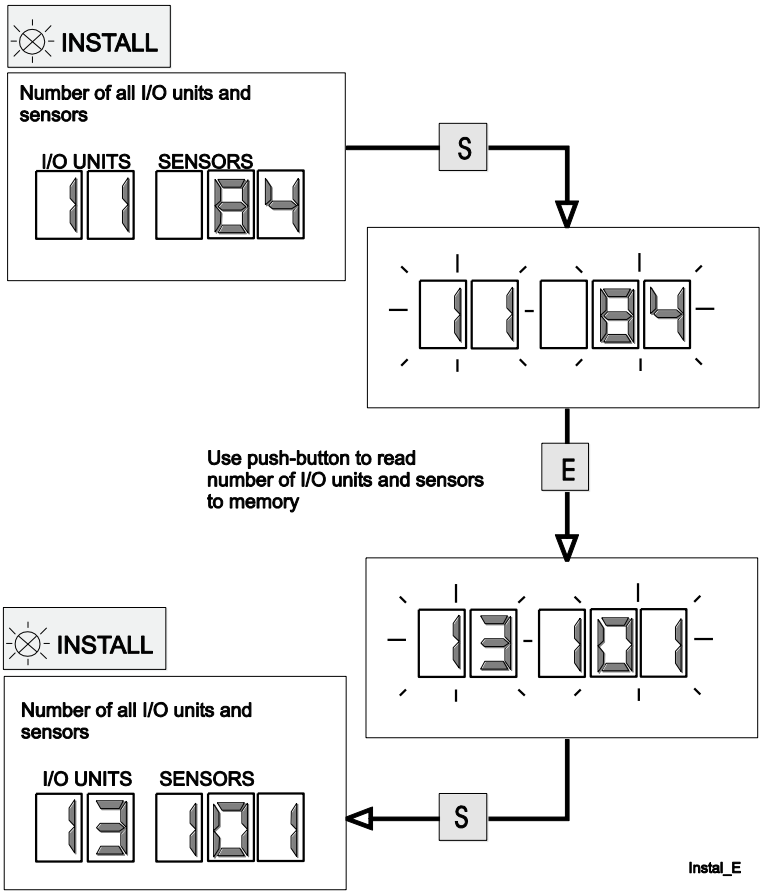


Figure 3.4-1 Reading system configuration into the central unit's memory

Once you have checked these and made any necessary corrections, you can connect supply voltage and read the system configuration into the central unit's memory as follows:

- Select the INSTALL mode using the up and down arrow keys.
- Press the S button to activate the INSTALL mode. The display starts blinking.
- Press E to start the reading.
- The central unit locates all I/O units connected to the system and their sensors. This takes some seconds. Once the configuration is complete, the display shows the number of I/O units and sensors.

NOTE! The current I/O unit normally indicates three sensors, even if the number of current transformers connected is only one or two.

- After reading the system configuration, the central unit automatically changes to normal mode.
- Check the configuration in the INFO mode according to section 3.4.1.
- When configurating arc protection system with multiple central units, disconnect I/O-units from central units in slave mode during their installation procedure.

3.4.1. Checking system configuration

To check system configuration in INFO mode, do the following:

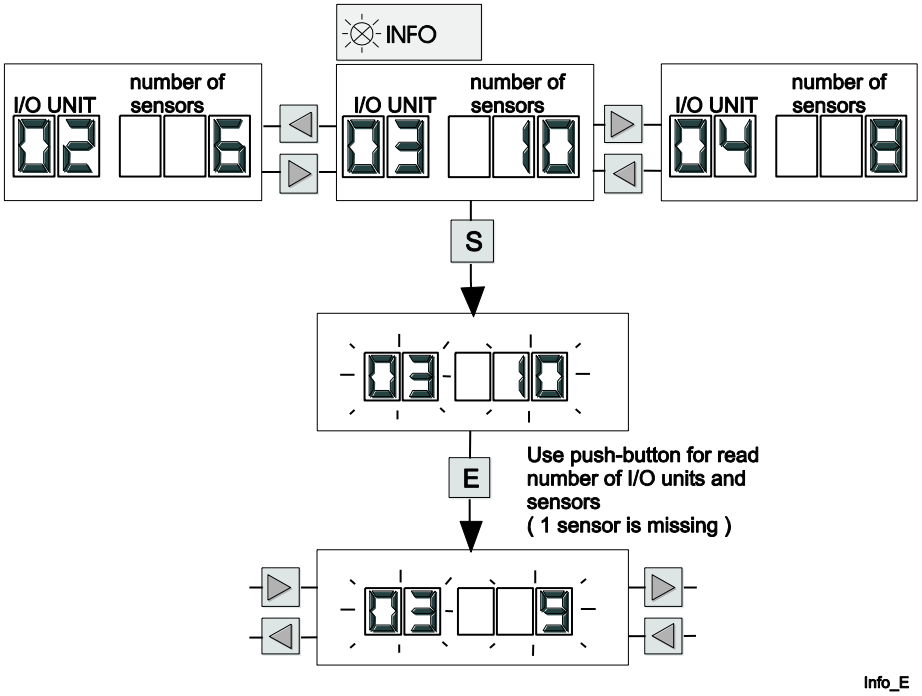


Figure 3.4.1-1 Checking system configuration in INFO mode

- Select the INFO mode using the up and down arrow keys.
- You can read the I/O unit address and the number of sensors stored in the memory from the central unit's display.
- Use the side arrow keys to move between the I/O units.
- When the correct I/O unit shows on the display, press S to activate the INFO mode.
- To check the number of connected sensors, press E.
- The central unit will display the number of sensors connected to the I/O unit for two seconds, after which it will show the number of sensors stored in the memory. If the numbers are not the same, see section 3.1.3.

NOTE! Checking system configuration will not affect the configuration stored in the central unit's memory. If you wish to modify the configuration, see section 3.4.

4. System commissioning

The following equipment is required for commission testing:

- Current supply for feeding either primary or secondary current.
- A flashlight or other source of bright light
- A multi-function measuring instrument including a clip-on ammeter and resistance measurement for verifying the operation of potential-free output contact.

The flashlight must be able to provide a sufficiently long light pulse for the sensors.

If you are using a torch, adjust the beam until its edge is sharp to ensure sensor activation.

Commissioning testing must be documented in writing, detailing system operation and settings.

4.1. Testing - general

Before initiating the testing, determine the system configuration and scope. Pay particular **attention to safety during the work** and ensure the testing will not cause unnecessary tripping of feeders that are in use.

Determine the following:

- Is any unit connected to another central unit or protection relay via a BI/O bus?
- Where have the trips been wired to from the central units and I/O units?
- What is the total number of I/O units and sensors? Has the system been configured as instructed? (see 3.4)
- Has any other protection or measuring equipment been connected to the current measuring circuits?

4.2. Performing the testing

The system should be tested systematically, since correct operation of the arc protection system guarantees personal safety.

- Activate each sensor separately and ensure at the central unit that the light information travels through the entire communication channel. Enter the test result of each sensor under item 4 of Table 4.2-1, for example.
- Once you have tested each sensor channel separately, activate a few sensor channels' together with current criteria and verify tripping (preferably at least one trip per I/O unit). Enter the activated channels under items 5 and 6 and the trip in column 7 in Table 4.2-1.
- If light or current identifier information is transferred from one central unit to another or between relays and the central unit through the BI/O bus, ensure that this information is transferred between the central units or between the relays and the central unit. Enter the light or current information (L > or I >) received by the central unit under item 2 in Table 4.2-12.
- Ensure the selectivity of the protection zones.

4.3. Periodic commissioning

We recommend that VAMP 221 arc protection system functionality shall be tested every five years or according to the law.

Name of station:	
Switchgear:	
Date of commission:	
Commissioners:	
Standards used:	

VAMP 221 serial number (1							
	Light	**Current**					
Does the unit receives BIO-message from other unit (2	**Y/N**	**Y/N**	**Sensor channel**	**Sensor channel status Y/N(4**	**Tripping from current and**		**Tripping ensured Y/N (7**
					Current Y/N (5	**Light Y/N (6**	
Address of I/O unit (3			1				
			2				
Selectivity of tripping ensured(8	**Y/N**		3				
			4				
			5				
			6				
			7				
			8				
			9				
			10				

Table 4.3-1 Example of testing protocol

Descriptions:

1. Information available on the unit’s name plate.
2. Read the activation of the BI/O channel from the central unit’s display.
3. Read the I/O unit’s address from the address selection switches.
4. Read the address of the activated indicator channel from the display of the central unit.
5. Current value exceeds the I> setting? (Y / N)
6. Light information activated L>? (Y / N)
7. Trip verified either from relay output contacts or breaker operation.
8. Selectivity checked though cross-testing.

5. Main properites

VAMP 221 is a modular system consisting of a central unit, I/O units, arc sensors and possible multiplying relays.

Due to its modularity, the system is suitable for a range of arc protection applications, from simple systems with one central unit and one I/O unit to more complex solutions comprising several central units used for selective arc protection.

The central unit VAMP 221 includes all arc protection system functions, such as overcurrent and arc supervision.

The I/O unit VAM 10L / VAM 10LD, VAM 12L / VAM 12LD serves as link between the system's point sensors and the central unit. Each I/O unit has connections for ten arc sensors, one portable pin sensor and one trip output.

The I/O unit VAM 3L/VAM3LX serves as link between the system's fibre sensors and the central unit. Each I/O unit has connections for three arc sensors, one pin sensor and one trip output.

The I/O unit VAM 4C / VAM 4CD serves as link between the system's current inputs and the central unit. Each I/O unit has connections for three current transformers and one trip output.

The arc sensor VA 1 DA is activated by strong light. The sensor transforms the light information into the current signal, which is forwarded through the I/O unit to the central unit. The arc sensor **VA 1 EH** also operates on the same principle.

The pin sensor VA 1 DP has the same functions as an arc sensor but can be temporarily connected to an I/O unit. The sensor can be fixed to the breast pocket of a technician to improve safety when working with live switchgear.

The multiplying relay VAR 4CE contains four normal open trip relays. The multiplying relay can be connected to the central

6. Functions

6.1. Protection functions

The arc protection functions of the arc protection relay are always operational. You can select the circuit breaker failure protection stage using the programming switches.

6.1.1. Arc (fault) protection (50ARC)

Arc protection involves the central unit, I/O units, a range of light sensitive elements and a instantaneous overcurrent stage module. The module can be connected to 1, 2 or 3-phase current or earth-fault current and 2-phase current.

Arc protection is operational when the light I/O unit transfers the light information from the arc sensor to the system and, simultaneously, overcurrent stage of the I/O unit status. These signals are visible in all system components, each of which generates an arc fault trip according to its own settings. The system or a system component can also be programmed to operate on light information alone.

The operating time of the arc protection stage is 7 ms.

6.1.2. Unbalance alarm

NOTE! Unbalance error has been removed from the software version 3.12 onwards.

The purpose of the unbalance alarm is to identify an abnormal distribution of load currents in the measuring circuit. Such abnormal situations occur mainly in connection with equipment failure or faulty secondary circuit wiring in current transformers.

The system uses either two-phase or three-phase connections. The system uses a two-phase connection, when the $L2/I_0$ overcurrent setting deviates from the L1/L2 overcurrent limit by more than 90%. When the settings are approximately the same, the phase discontinuity function monitors all three current phases.

The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. Single-phase current or earth-fault current must always be connected to the current measuring channel $L2/ I_0$; otherwise, an unbalance error will occur.

The protection is solely based on measuring the magnitudes of the phase currents. If the detected deviation exceeds 90%, the system

gives an unbalance alarm after a 10-second delay time. The alarm does not affect other operations of the arc protection system.

The phase discontinuity settings are non-adjustable, since all the setting values have been programmed in the current measuring unit.

6.1.3. Circuit breaker failure protection stage (50BF)

The circuit breaker failure protection stage (CBFP) is based on operating time monitoring. The operating time is calculated as the time from the tripping of the trip relay until it resets. If the operating time exceeds the CBFP operating delay time, it activates another output relay, which remains active until the primary trip relay resets.

In CBFP, TRIP 2 provides CBFP if master unit measures overcurrent and any light zone is activated. TRIP 4 provides CBFP if overcurrent information comes from other unit e.g. VAM 4C and any light zone is activated.

CBFP setting parameters:

VAMP 221

Parameter	Value	Unit	Default	Description
SW1-3	ON/OFF		OFF	CBFP options: OFF: CBFP in use ON: CBFP not in use
SW1-4	ON/OFF		OFF	CBFP delay time options: OFF: delay time 100 ms ON: delay time 150 ms

6.2. Measurements

The central unit VAMP 221 has a three-phase current measuring function that can be used to measure either three phase currents or two phase currents and a summation current. Current measuring is indicated on the display of the central unit.

The current I/O unit VAM 4C has a current measuring function but no indication. The unit only gives an indication when the measured current exceeds the current limit setting.

6.3. Output relay functions

The central unit VAMP 221 has four trip relays, which can be controlled as two tripping groups (two contacts in each group). One contact in each group can be used to trip the CBFP stage. The central unit also has a general contact for arc fault trip alarms and two contacts for internal fault alarms.

The tripping groups are controlled using the trip relay matrix.

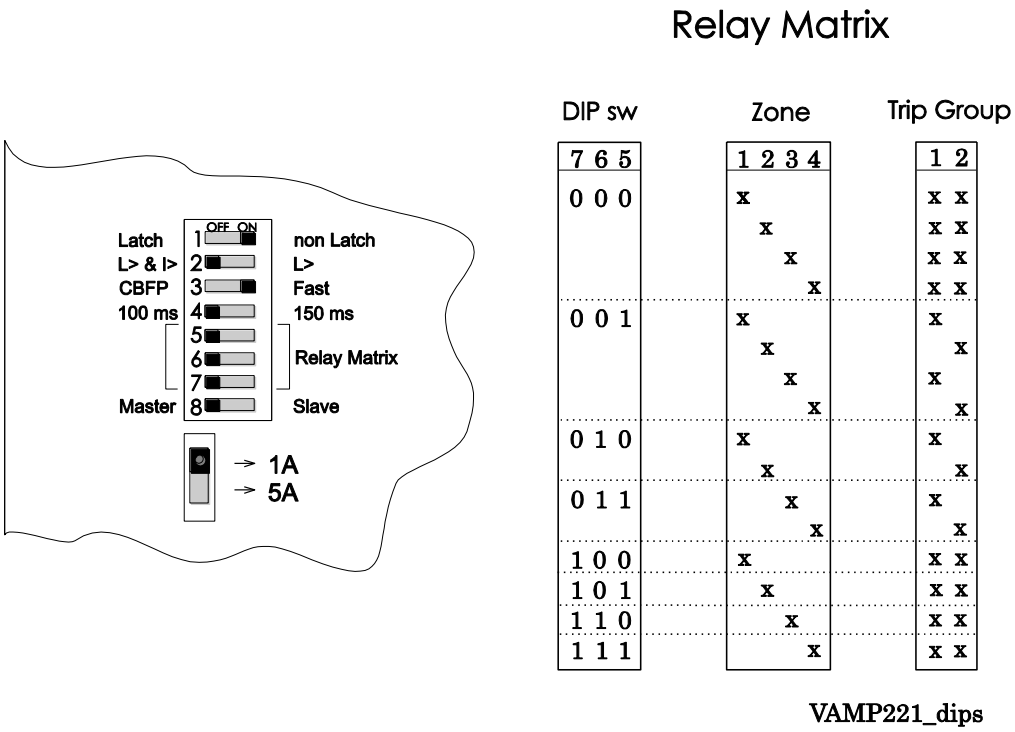


Figure 6.3-1 VAMP 221 relay matrix

The output trip relays of the central unit can also operate selectively during arc faults in different protection zones.

The output trip relays of the I/O units can also be used for tripping in different protection zones. Each I/O unit has one output trip relay, which trips either in faults in its own zone (VAM 10L and VAM 3L / VAM 3LX) or in the programmed zone (VAM 4C). I/O unit VAM 12L / VAM 12LD comprises 3 output relays.

If necessary, trips can be multiplied using the multiplying relay VAR 4CE.

6.4. Self-supervision

The system monitors the microcontroller and related circuit operation, and program execution with a separate supervision circuit. In addition to system supervision, the circuit attempts to re-start the microcontroller in the event of a fault. If the re-start fails, the supervision circuit gives a self-supervision alarm on a permanent internal fault. In case of am microcontroller failure the trip functions still works but latching is blocked.

Whenever the supervision circuit detects a permanent fault in any system component it ignores activation signals coming from this component e.g. faulty arc sensor.

The supervision circuit also monitors the internal operating voltage. In the event of loss of operating voltage in the central unit, the system automatically gives an IF alarm, since the IF output relay operates on steady-state current; in other words, the IF relay is actuated when the operating voltage is on and within the permitted limits.

6.5. BI/O bus interface

All VAMP 221 Arc Protection System units can receive or transmit light and/or current criteria (depending on the unit) on the BI/O bus.

VAMP 221 can send BI/O information to two central units or two protection relays. If there are more than two recipients of BI/O information or the length of the BI/O bus exceeds 100 m, the BI/O bus must be equipped with a line amplifier as shown in the figure below.

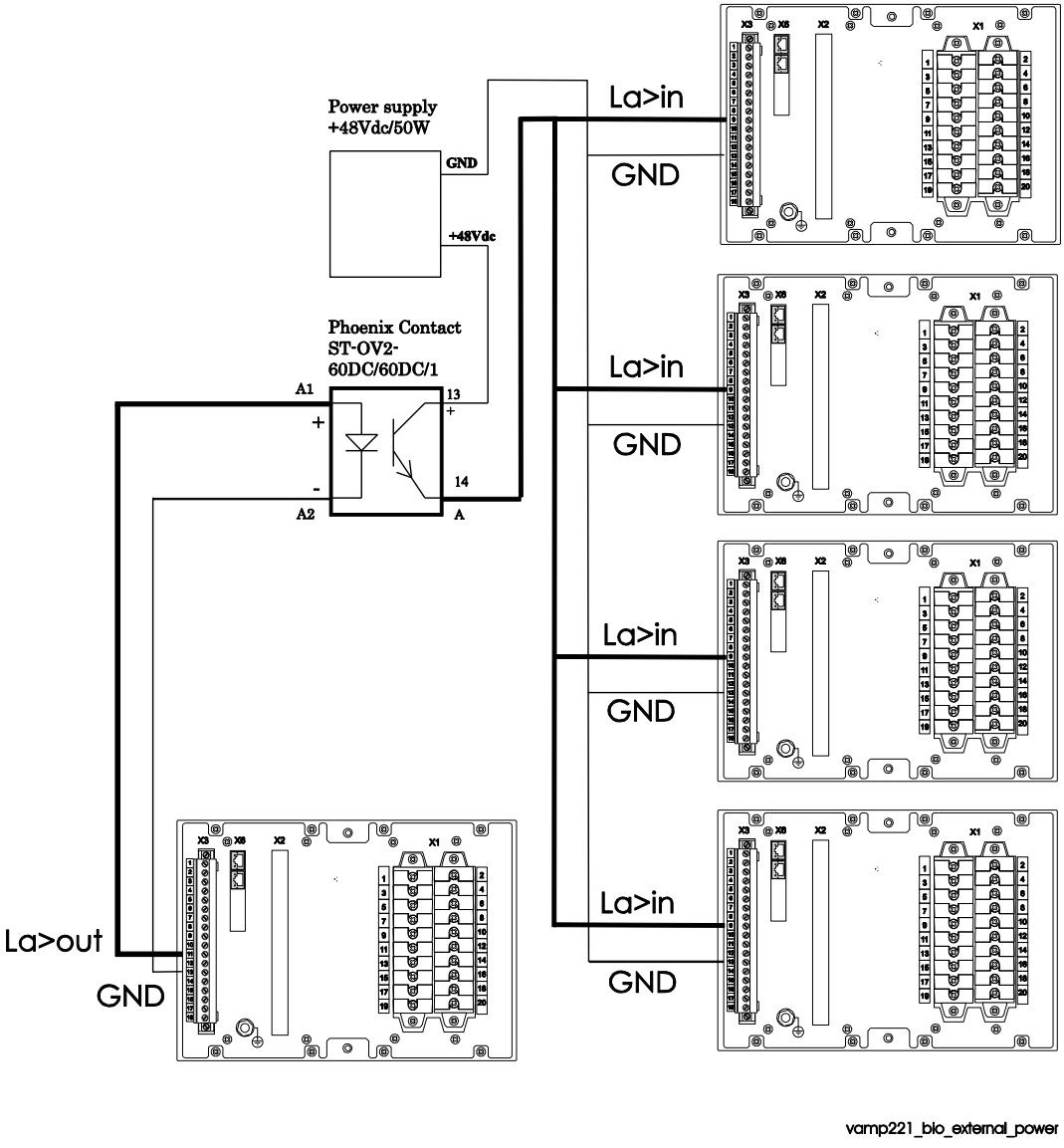


Figure 6.5-1 We recommend the Phoenix Contact ST-OV2-60DC/60DC/1 as the line amplifier

6.5.1. Connection to another central unit

In applications with multiple central units the central units can be interconnected also via BI/O connections (binary input/output). In this case, each part of the system can control four protection zones per system communication bus. In this case, arc and overcurrent information is transferred between the central units without address information.

The following BI/O connections are included in the standard delivery:

La>in	X3-8	Arc input, tripping group 1
Lb>in	X3-9	Arc input, tripping group 2
Ib> in/out	X3-10	Overcurrent input/output
La> out	X3-11	Arc output, tripping group 1
Lb> out	X3-12	Arc output, tripping group 2
GND	X3-13, X3-14	Grounding for all BI/O signals

6.5.2. Connection to I/O unit

Each I/O unit also has a BI/O bus. The light I/O units (VAM 12L / VAM 12LD,VAM 10L / VAM 10LD, VAM 3L / VAM 3LX) can transmit trip information to the central unit or current I/O unit. The current I/O unit (VAM 4C / VAM 4CD) can receive the light information and send the current information either to other I/O units or the multiplying relay.

The following DI and DO connections are included in the standard delivery of VAM 10L and VAM 3L / VAM 3LX units:

DI	X2-8	Zone shift 1→2, 2→1, 3→4, 4→3
GND	X2-7	
Trip out	X2-10	Trip information, 24 V dc
GND	X2-9	Trip information earth

The following DI and DO connections are included in the standard delivery of VAM 4C units:

L>in	X2-8	Light input, 24-48 V dc
GND	X2-7	Light input earth
Trip out	X2-10	Trip information
GND	X2-9	Trip information earth

6.5.3. Connection to protection relay

The VAMP 221 Arc Protection System can also send light or current criteria to other VAMP protection relays, if they are equipped with an arc protection circuit board (optional). The voltage level of the connected signal must be 48 V dc, which means the I/O units alone cannot send their signals directly to the protection relay. See the relay manual for more information on BI/O bus connections.

7. Application examples

This Chapter describes some technical application examples of the VAMP 221 arc protection system.

7.1. Selective fibre solution, 3 incomers, 3 protection zones, CBFP in use

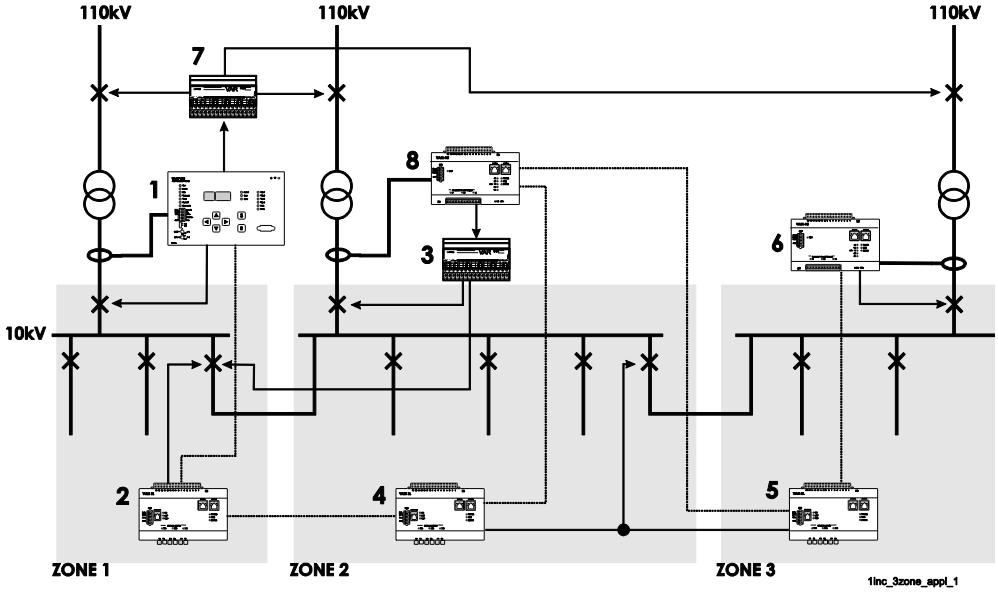


Figure7.1-1 Selective fibre solution, 3 incomers, 3 protection zones, CBFP in use

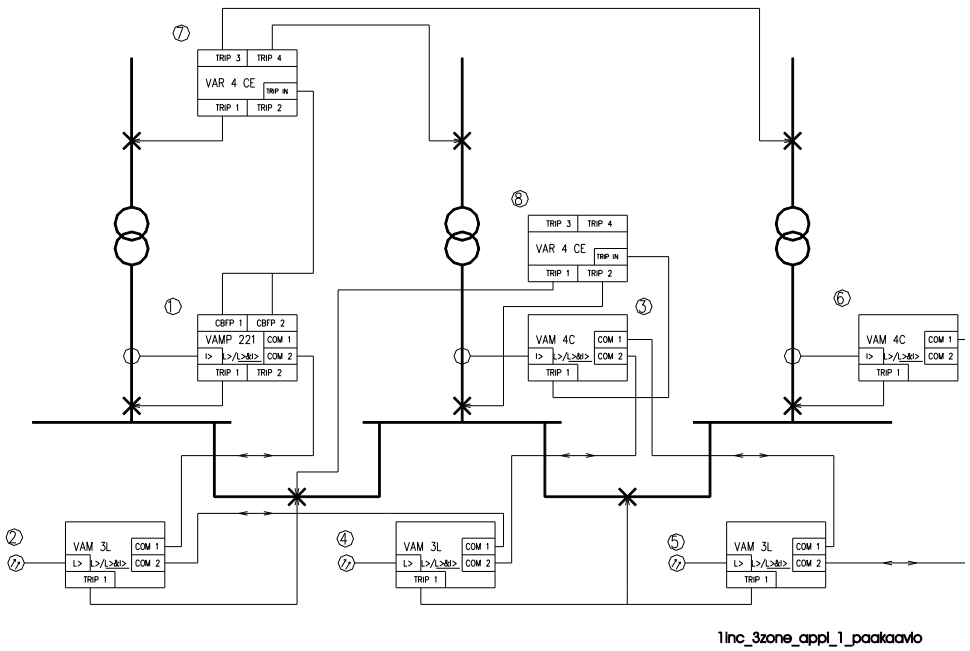


Figure 7.1-2 Selective fibre solution, 3 power flow directions, 3 protection zones, CBFP in use

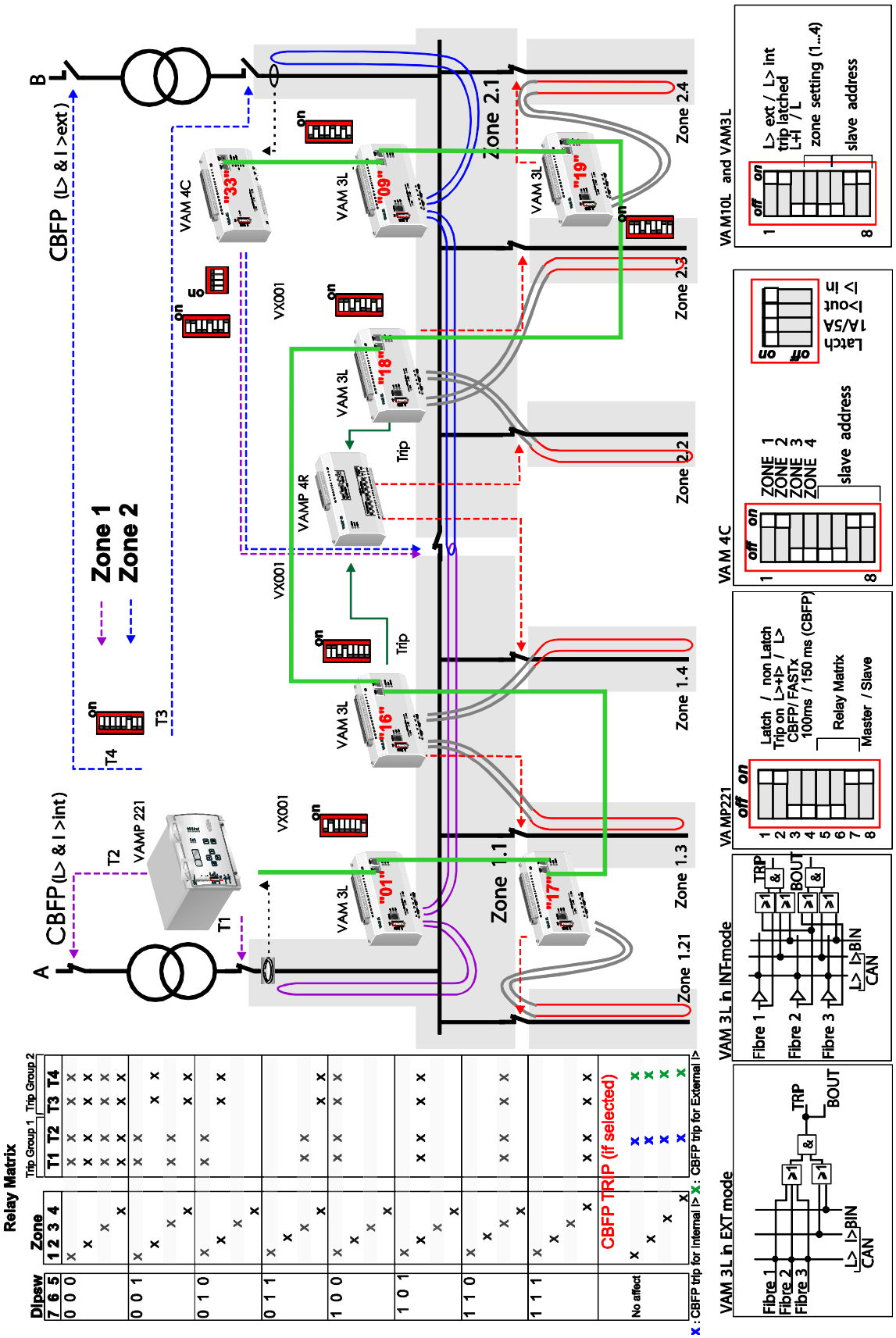


Figure 7.1-3 Selective feeder solution with VAM 3L in internal mode (dip sw # 1 "ON")

7.1.1. Functional system description

The protected installation is medium voltage switchgear with three separate incomers. The switchgear has longitudinal busbars between the incomers.

To minimize the fault zone, the switchgear is divided into three separate zones when structurally possible. The different zones are limited by circuit breakers and monitored by arc sensors (2,4 and 5). The system receives current criteria from the central unit (1) and current I/O units (3 and 6), which have been installed at the incomers.

Switchgear back-up protection has been ensured by wiring the CBFP contacts to the upper side of the supply transformers. When setting the CBFP delay time, the standard break-time of the feeder circuit breaker of the switchgear must be taken into account. This may be very long for old circuit breakers.

The central unit, I/O units and multiplying relays (7 and 8) serve as trip units. The central unit (1) trips its own feeder circuit breaker in zone 1 faults (tripping group 1) and serves as CBFP in zone 1, 2 and 4 faults (tripping groups 1 and 2), if the current limit is exceeded. The multiplying relay (7) multiplies the CBFP trip to all upstream circuit breakers. The arc sensor I/O unit (2) trips the bus-coupler circuit breaker between zones 1 and 2 in faults in its own zone. The zone 2 current I/O unit (3) trips its own input circuit and the bus-coupler circuit breaker between zones 1 and 2. The trip has been multiplied with the trip multiplier relay (8). The arc sensor I/O units (4 and 5) trip the bus-coupler circuit breaker between zones 2 and 4 in faults in their own zone. The zone 3 current I/O unit (6) trips its own incomer circuit breaker, and arc I/O unit (5) trips the tie-breaker to this zone.

Arc alarm is taken from the alarm relay of the central unit, which activates in faults in all zones. System self-supervision alarm is also taken from the central unit alarm relay.

7.1.2. System components

The system configuration comprises the following components:

- one (1) VAMP 221 central units
- two (2) VAM 4C current I/O unit
- three (3) VAM 3L fibre I/O units
- two (2) VAR 4CE multiplying relays
- six (6) ARC-SLx fibre sensors

7.1.3. System configuration

Configuration of the central unit VAMP 221 (1)

SW1 switch settings

Switch	Definition	Setting	Description
1	Latch	0	Position ”1” (switch on the right): trip relay is only operational while the protection is activated Position ”0” (switch on the left) trip relay changes to latching status after trip
2	L>&I> / L>	0	Position ”0” (switch on the left): trip is activated by arc and current criteria Position ”1” (switch on the right) - trip is activated by light criteria alone
3	CBFP/ Fast	0	Position ”0” (switch on the left): output trip relays 2 and 4 serve as CBFP Position ”1” (switch on the right) output trip relays 2 and 4 serve as fast trip
4	CBFP 100/150 ms	1	Position ”0” (switch on the left): CBFP delay time 100 ms Position ”1” (switch on the right) CBFP delay time 150 ms
5	Relay matrix	0	Relay matrix
6	Relay matrix	1	Relay matrix
7	Relay matrix	0	Relay matrix
8	central unit/sub-unit	0	Position ”0” (switch on the left): central unit in central unit mode Position ”1” (switch on the right) central unit in sub-unit mode

Since VAMP 221 serves as the central unit for I/O units, VAMP 221 must be in the central unit operating mode.

Current pick-up setting potentiometer settings L1/L3 and L2/I_0

L1 / L3

Potentiometer settings are used to set the light activation level for phase currents I_{L1} and I_{L3}. The setting zone is 0.5 … 6 x I_n. This current setting is separate from the I_{L2}/I_0 setting.

L2 / Io

Potentiometer settings are used to set the light activation level for phase currents I_{L2} or earth-fault current I_0. The setting zone is 0.05 … 5 x I_n. This current setting is separate from the I_{L1}/I_{L3} setting.

NOTE! If three phase currents are connected to the central unit, both L1/L3 and L2 settings must be made.

Configuration of the current I/O unit VAM 4C and VAM 4CD (3 and 6)

SW1 switch settings

Switch	Definition	VAM4C(3) Setting	VAM4C(6) Setting	Description
1	Zone 1	0	0	System operating zone 1 (light information)
2	Zone 2	1	0	System operating zone 2 (light information)
3	Zone 3	0	1	System operating zone 3 (light information)
4	Zone 4	0	0	System operating zone 4 (light information)
5	Addr	0	0	Address weighting coefficient 8
6	Addr	0	0	Address weighting coefficient 4
7	Addr	0	1	Address weighting coefficient 2
8	Addr	1	0	Address weighting coefficient 1

VAM 4C (3) address ”1” (33)

VAM 4C (6) address “2” (34)

SW2 switch settings

Switch	Definition	VAM4C(3) Setting	VAM4C(6) Setting	Description
1	Latch	1	1	Position ”0” (switch down): trip relay is only operational while the protection is activated Position ”1” (switch up): trip relay changes to latching status after trip
2	1A / 5A	0 *)	0 *)	Position ”0” (switch down): rated secondary current of the current transformer is 1 A Position ”1” (switch up): rated secondary current of the current transformer is 5 A
3	I> out	1	1	Position ”0” (switch down): unit does not transmit the current criteria to other units Position ”1” (switch up): unit transmits the current criteria to other units
4	I> in	1	1	Position ”0” (switch down): unit does not receive the current criteria from other units Position ”1” (switch up): unit receives the current criteria from other units

*) As in CT

Current pick-up setting potentiometer settings L1/L3 and L2/I_0

L1 / L3

Potentiometer settings are used to set the light activation level for phase currents I_{L1} and I_{L3}. The setting zone is 0.5 … 6 x I_n. This current setting is separate from the I_{L2}/I_0 setting.

L2 / I_0

Potentiometer settings are used to set the light activation level for phase currents I_{L2} or earth-fault current I_0. The setting zone is 0.05 … 5 x I_n. This current setting is separate from the I_{L1}/I_{L3} setting.

NOTE! If three phase currents are connected to the I/O unit, both L1/L3 and L2 settings must be made.

Configuration of the fibre I/O unit VAM 3L and VAM 3LX (2,4 and 5)

SW1 switch settings

Switch	Definition	VAM3L(2) Setting	VAM3L(4) Setting	VAM3L(5) Setting	Description
1	BIO	1	1	1	Position ”0” (switch on the left) BIO out sends light information Position ”1” (switch on the right): BIO out sends overcurrent information
2	Latch	1	1	1	Position ”0” (switch on the left) trip relay is only operational while the protection is activated Position ”1” (switch on the right) trip relay changes to latching status after trip
3	L+I / L	0	0	0	Position ”0” (switch on the left) trip is activated by arc and current criteria Position ”1” (switch on the right) trip is activated by light criteria alone
4	Addr	0	0	1	Address weighting coefficient 16
5	Addr	0	1	0	Address weighting coefficient 8
6	Addr	0	0	0	Address weighting coefficient 4
7	Addr	0	0	0	Address weighting coefficient 2
8	Addr	0	0	0	Address weighting coefficient 1

VAM 3L (2) unit address 0 (protection zone 1)

VAM 3L (4) unit address 8 (protection zone 2)

VAM 3L (5) unit address 16 (protection zone 3)

7.1.4. Testing of example application

NOTE! For general testing instructions, see Chapter 4.

Testing of the central unit VAMP 221 (1)

The system is configured in INSTALL mode once the settings of each system component have been completed. You can verify the system configuration against the physical connections in the INFO mode.

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I_n). You can monitor unit activation by the I>int indicator light.

To verify the setting value, feed the targeted start current to the current channel L2 or I_0 (for example, 3 x I_n). You can monitor unit activation by the I>int indicator light.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a fault alarm (alarm No. 18). This alarm will not prevent unit operation, however. Each unbalance alarm must be separately acknowledged in the central unit.

NOTE! Unbalance error has been removed from the software version 3.12 onwards.

Testing of the current I/O unit VAM 4C and VAM 4CD (3.6)

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I_n). Then turn the potentiometer until the unit activates and the L1 or L3 current channel indicator light is lit.

To verify the setting value, feed the targeted start current to the current channel L2 or I_0 (for example, 3 x I_n). Then turn the potentiometer until the unit activates and the L2 or I_0 current channel indicator light is lit. When the overcurrent stage on VAM 4C is activated the I>ext indicator on central unit will also lit.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a blinking LED in connection with the deviating phase. The unit also sends a fault alarm to the central unit, where it must be separately acknowledged. This alarm will not prevent unit operation, however.

Testing of the fibre I/O unit VAM 3L and VAM 3LX (2, 4, 5)

To verify the transfer of the light information, activate each fibre loop sensor using a powerful light source, such as a flashlight. If VAM 3LX is used, the sensitivity of light input is adjustable for each fibre loops with channel adjustments “CH1 Adj.”, “CH2 Adj.” and “CH3 Adj.” To verify the data transfer, check the light activation from the unit’s indicator lights and central unit display.

Testing of overall system operation

Feed a test current exceeding the current limit to the current channels of the central unit and the current I/O units. To obtain light information, activate each light I/O unit (at least one light criterion per I/O unit). Verify tripping and its selectivity.

Verify the trip circuit wiring by tripping each system circuit breaker at least once using the system’s output trip relay.

Fill in a testing report (see model report in the User’s Manual) during the test.

Close the hard wire connection terminals opened during testing and remove temporary connections. The system is ready for commissioning.

7.2. Selective sensor solution, 2 incomers, 2 protection zones, CBFP in use

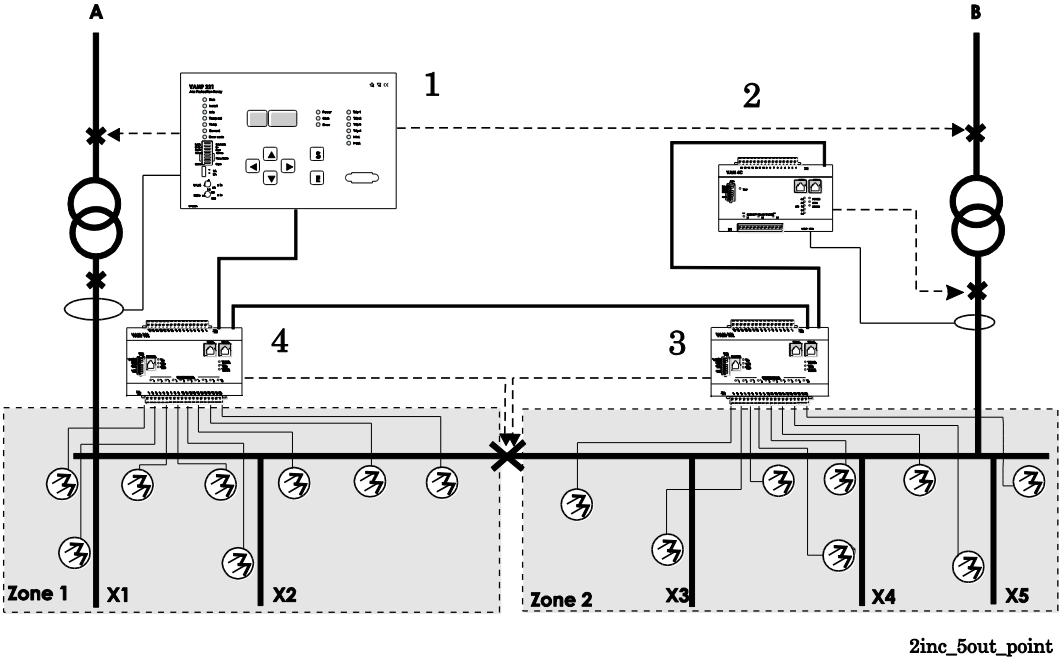


Figure 7.2-1 Selective sensor solution, 2 power flow directions, 2 protection zones, CBFP in use

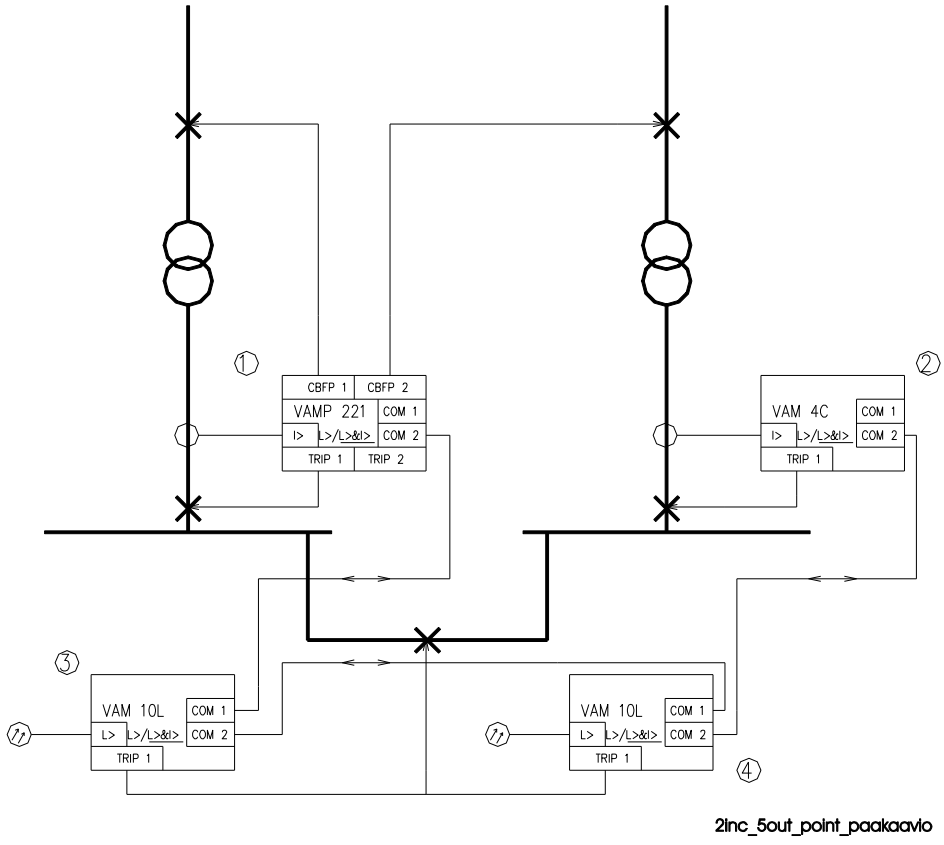


Figure 7.2-2 Selective sensor solution, 2 power flow directions, 2 protection zones, CBFP in use

7.2.1. Functional system description

The protected object is medium voltage switchgear with two separate inputs. The switchgear has a longitudinal busbar in a bus-bar between the inputs. See Figures 3.2-1 and 3.2-2.

To minimize the fault zone, the switchgear is divided into two separate zones when structurally possible. The different zones are limited by bus-coupler circuit breakers and monitored by light sensors VA 1 DA connected to the light I/O unit 3 and 4. The system receives current criteria from the central unit (1) and current I/O unit (2), which have been installed on incomers.

Switchgear protection has been ensured by wiring the CBFP contacts to the opposite side of the supply transformers. When setting the CBFP delay time, the standard break-time of the feeder circuit breaker of the actual switchgear must be taken into account. This may be very long for old circuit breakers.

The central unit and I/O units serve as trip units. The central unit (1) trips its own feeder circuit breaker in zone 1 faults (tripping group 1) and serves as CBFP in zone 1 and 2 faults (tripping groups 1 and 2), if the current limit is exceeded. The arc sensor I/O units (3 and 4) trip the bus-coupler circuit breaker between zones 1 and 2 in faults in their own zone. The zone 2 light I/O unit (3) trips its own bus-coupler circuit breaker.

Arc alarm is taken from the alarm relay of the central unit, which activates in faults in all zones. System self-supervision alarm is also taken from the central unit alarm relay.

7.2.2. System components

The system configuration comprises the following components:

- one (1) VAMP 221 central units
- one (1) VAM 4C current I/O unit
- two (2) VAM 10L light I/O units
- sixteen (16) VA 1 DA light sensitive elements

7.2.3. System configuration

Configuration of the central unit VAMP 221 (1)

SW1 switch settings

Switch	Definition	Setting	Description
1	Latch	1	Position ”0” (switch on the left): trip relay is only operational while the protection is activated Position ”1” (switch on the right) trip relay changes to latching status after trip
2	L>&I> / L>	0	Position ”0” (switch on the left): trip is activated by arc and current criteria Position ”1” (switch on the right) trip is activated by light criteria alone
3	CBFP/Fast	0	Position ”0” (switch on the left): output trip relays 2 and 4 serve as CBFP Position ”1” (switch on the right) output trip relays 2 and 4 serve as fast trip
4	CBFP 100/150 ms	1	Position ”0” (switch on the left): CBFP delay time 100 ms Position ”1” (switch on the right) CBFP delay time 150 ms
5	Relay matrix	1	Relay matrix
6	Relay matrix	0	Relay matrix
7	Relay matrix	0	Relay matrix
8	central unit/sub-unit	0	Position ”0” (switch on the left): central unit in central unit mode Position ”1” (switch on the right) central unit in sub-unit mode

Since VAMP 221 serves as the central unit for I/O units, VAMP 221 must be in the central unit operating mode.

Current pick-up setting potentiometer settings L1/L3 and L2/I_0

L1 / L3

Potentiometer settings are used to set the light activation level for phase currents IL1 and IL3. The setting zone is 0.5 … 6 x I_N. This current setting is separate from the I_{L2}/I_0 setting.

L2 / I_0

Potentiometer settings are used to set the light activation level for phase currents I_{L2} or earth-fault current I_0. The setting zone is 0.05 … 5 x I_N. This current setting is separate from the I_{L1}/I_{L3} setting.

NOTE! If three phase currents are connected to the central unit, both L1/L3 and L2 settings must be made.

Configuration of the current I/O unit VAM 4C and VAM 4CD (2)

SW1 switch settings

Switch	Definition	VAM4C(2) Setting	Description
1	Zone 1	0	System operating zone 1 (light information)
2	Zone 2	1	System operating zone 2 (light information)
3	Zone 3	0	System operating zone 3 (light information)
4	Zone 4	0	System operating zone 4 (light information)
5	Addr	0	Address weighting coefficient 8
6	Addr	0	Address weighting coefficient 4
7	Addr	0	Address weighting coefficient 2
8	Addr	1	Address weighting coefficient 1

VAM 4C (2) address ”1” (33)

SW2 switch settings

Switch	Definition	VAM4C(2) Setting	Description
1	Latch	1	Position ”0” (switch down): trip relay is only operational while the protection is activated Position ”1” (switch up): trip relay changes to latching status after trip
2	1A / 5A	0 *)	Position ”0” (switch down): rated secondary current of the current transformer is 1 A Position ”1” (switch up): rated secondary current of the current transformer is 5 A
3	I> out	1	Position ”0” (switch down): unit does not transmit the current criteria to other units Position ”1” (switch up): unit transmits the current criteria to other units
4	I> in	1	Position ”0” (switch down): unit does not receive the current criteria from other units Position ”1” (switch up): unit receives the current criteria from other units

*) As in CT

Current pick-up setting potentiometer settings L1/L3 and L2/I_0

L1 / L3

Potentiometer settings are used to set the light activation level for phase currents I_{L1} and I_{L3}. The setting zone is 0.5 … 6 x I_N. This current setting is separate from the IL2/I_0 setting.

L2 / I_0

Potentiometer settings are used to set the light activation level for phase currents I_{L2} or earth-fault current I_0. The setting zone is 0.05 … 5 x I_N. This current setting is separate from the I_{L1}/I_{L3} setting.

NOTE! If three phase currents are connected to the I/O unit, both L1/L3 and L2 settings must be made.

Configuration of the light I/O unit VAM 10L and VAM 10 LD (3 and 4)

SW1 switch settings

Switch	Definition	VAM10L(3) Setting	VAM10L(4) Setting	Description
1	L> ext/int	0	0	Position ”1” (switch on the right) unit does not receive the light criteria from other units Position ”0” (switch on the left): unit receives the light criteria from other units in the same protection zone
2	Latch	1	1	Position ”0” (switch on the left) trip relay is only operational while the protection is activated Position ”1” (switch on the right) trip relay changes to latching status after trip
3	L+I / L	0	0	Position ”0” (switch on the left) trip is activated by arc and current criteria Position ”1” (switch on the right) - trip is activated by light criteria alone
4	Zone 4	0	0	Address weighting coefficient 16
5	Addr	0	1	Address weighting coefficient 8
6	Addr	0	0	Address weighting coefficient 4
7	Addr	0	0	Address weighting coefficient 2
8	Addr	0	0	Address weighting coefficient 1

VAM 10L (3) unit address “0” (protection zone 1)

VAM 10L (4) unit address “8” (protection zone 2)

7.2.4. System testing

Testing of the central unit VAMP 221 (1)

The system is configured in INSTALL mode once the settings of each system component have been completed. You can verify the system configuration against the physical connections in the INFO mode.

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I_N). You can monitor unit activation on the current measuring display and by the I>int indicator light.

To verify the setting value, feed the targeted start current to the current channel L2 or I_0 (for example, 3 x I_N). You can monitor unit activation on the current measuring display and by the I>int indicator light.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a fault alarm (alarm No. 18). This alarm will not prevent unit operation, however. Each unbalance alarm must be separately acknowledged in the central unit.

NOTE! Unbalance error has been removed from the software version 3.12 onwards.

Testing of the current I/O unit VAM 4C and VAM 4CD (2)

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I_N). Then turn the potentiometer until the unit activates and the L1 or L3 current channel indicator light is lit.

To verify the setting value, feed the targeted start current to the current channel L2 or I_0 (for example, 3 x I_N). Then turn the potentiometer until the unit activates and the L2 or I_0 current channel indicator light is lit.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a blinking LED in connection with the deviating phase. The unit also sends a fault alarm to the central unit, where it must be separately acknowledged. This alarm will not prevent unit operation, however.

Testing of the light I/O unit VAM 10L and VAM 10LD (4, 5)

To verify the transfer of the light information, activate each sensor using a powerful light source, such as a flashlight. To verify the data transfer, check the light activation from the unit's indicator lights and central unit display.

Testing of overall system operation

Feed a test current exceeding the current limit to the current channels of the central unit and the current I/O units and provide light information for each light I/O unit (at least one light criterion per I/O unit). Verify tripping and its selectivity.

Verify the trip circuit wiring by tripping each system circuit breaker at least once using the system's output trip relay.

Fill in a testing report (see model report in the User's Manual) during the test.

Close the hard wire connection terminals opened during testing and remove temporary connections. The system is ready for commissioning.

7.3. Selective point sensor solution, multiple incomers, multiple protection zones, CBFP in use

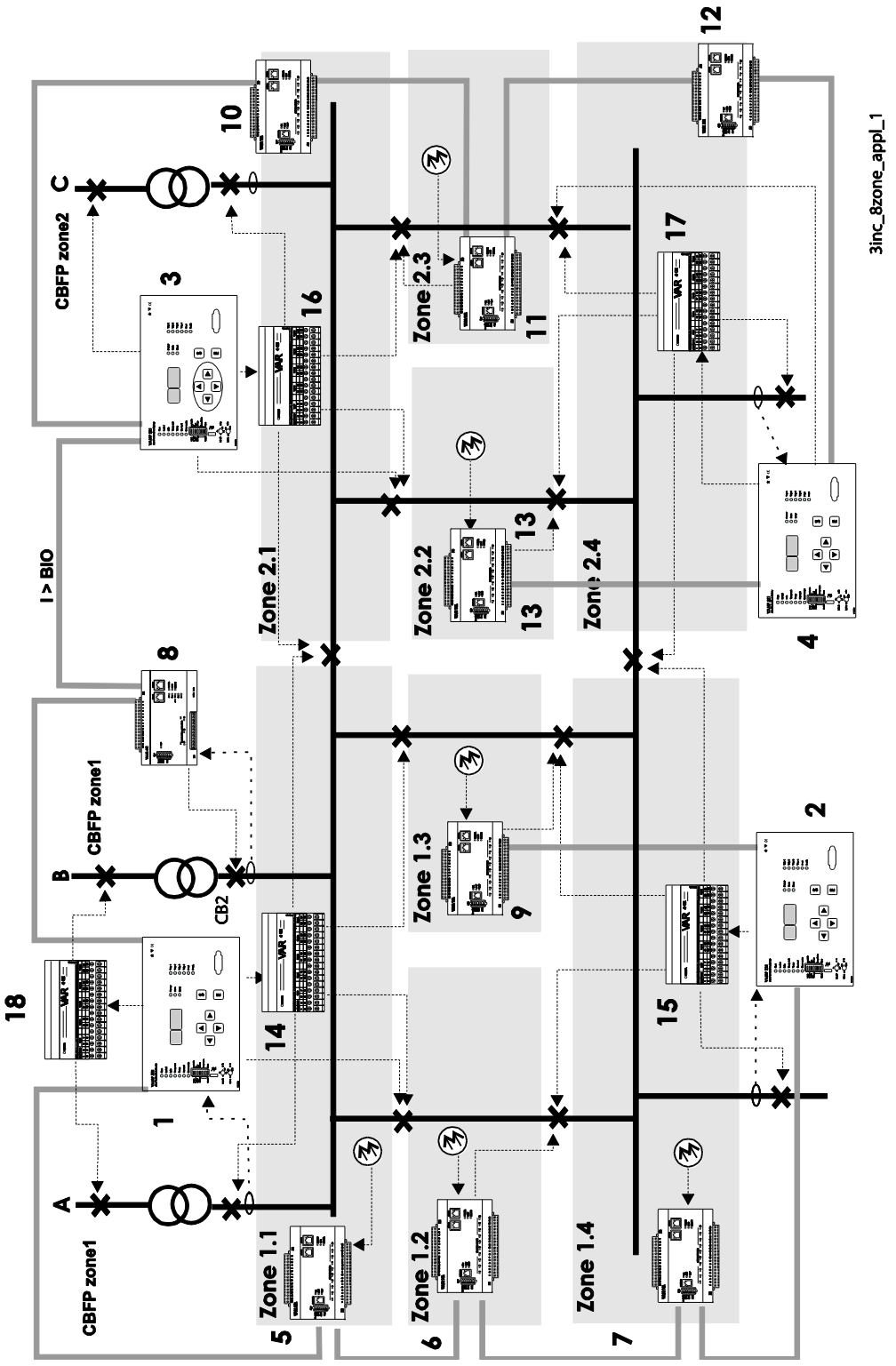


Figure 7.3-1 Selective fibre sensor solution, multiple power flow dierections, multiple protection zones, CBFP in use

7.3.1. Functional system description

The protected installation is an extensive industrial medium-voltage distribution system comprising two switchgears and five supplies. The switchgears have longitudinal busbars in a bus-bar between the inputs. The system also monitors the auxiliary supply connections, each one of which forms a separate protection zone. The system comprises two independent systems connected to each other with a BI/O bus, which makes it possible to use several protection zones.

To minimize the fault zone, the switchgear is divided into two separate zones when structurally possible. The different zones are limited by bus-coupler circuit breakers and monitored by light sensitive elements (5, 7, 10 and 12). The system receives current criteria from the central units (1, 2, 3 and 4) and current I/O unit (8), which have been installed on incomers. The auxiliary supply connections are monitored by light sensitive elements (5, 7, 10 and 12).

Switchgear protection has been ensured by wiring the CBFP contacts to the opposite side of the supply transformers. When setting the CBFP delay time, the standard break-time of the feeder circuit breaker of the actual switchgear must be taken into account. This may be very long for old circuit breakers.

The central units, I/O units and multiplying relays (14, 15, 16, 17 and 18) serve as trip units.

The central unit (1) trips its own feeder circuit breaker and those between zones 1.1 and 1.2, 1.1 and 1.3, and 1.1 and 2.1 in zone 1.1 faults (tripping group 1) and serves as CBFP in faults in these zones (tripping group 1) if the current limit is exceeded. The trip has been multiplied with a relay (14). In addition, the central unit (1) trips the circuit breaker between zones 1.1 and 1.2 in zone 1.2 faults (tripping group 2) if the current limit is exceeded. CBFP tripping is multiplied for each feeder circuit breaker with a relay (18).

The central unit (2) trips its own feeder circuit breaker and those between zones 1.2 and 1.4, 1.3 and 1.4, and 1.4 and 2.4 in zone 1.4 faults (tripping group 2) if the current limit is exceeded. The trip has been multiplied with a relay (15). In addition, the central unit (2) trips the circuit breaker between zones 1.3 and 1.1 in zone 1.1 faults (tripping group 1) if the current limit is exceeded.

The central unit (3) trips its own feeder circuit breaker and those between zones 2.1 and 2.2, 2.1 and 2.3, and 1.1 and 2.1 in zone 2.1 faults (tripping group 1) and serves as CBFP in faults in these zones (tripping group 1) if the current limit is exceeded. The trip has been multiplied with a relay (16). In addition, the central unit

(2) trips the circuit breaker between zones 2.1 and 2.2 in zone 2.2 faults (tripping group 2) if the current limit is exceeded.

The central unit (4) trips its own feeder circuit breaker and those between zones 2.2 and 2.4, 2.3 and 2.4, and 1.4 and 2.4 in zone 2.4 faults (tripping group 1) if the current limit is exceeded. The trip has been multiplied with a relay (17). In addition, the central unit (4) trips the circuit breaker between zones 2.3 and 2.4 in zone 2.4 faults (tripping group 2) if the current limit is exceeded.

The current I/O unit (8) trips its own bus-coupler circuit breaker in zone 1.1 faults, if the current limit is exceeded.

The arc sensor I/O unit (6) trips the circuit breaker between zones 1.2 and 1.4 in faults in its own zone.

The arc sensor I/O unit (9) trips the circuit breaker between zones 1.3 and 1.4 in faults in its own zone.

The arc sensor I/O unit (13) trips the circuit breaker between zones 2.2 and 2.4 in faults in its own zone.

The arc sensor I/O unit (11) trips the circuit breaker between zones 2.1 and 2.3 in faults in its own zone.

Arc alarm is taken from the alarm relays of the central units, which activate in faults in all zones. System self-supervision alarms are also taken from the central unit alarm relays.

7.3.2. System components

The system configuration comprises the following components:

- four (4) VAMP 221 central units
- one (1) VAM 4C current I/O unit
- eight (8) VAM 10L current I/O units
- a maximum of eighty (80) VA 1 DA light sensitive elements
- five (5) VAR 4CE multiplying relays

7.3.3. System configuration

Configuration of the central unit VAMP 221 (1,2,3 and 4)

SW1 switch settings

Switch	Definition	VAMP221(1) Setting	VAMP221(2) Setting	VAMP221(3) Setting	VAMP221(4) Setting	Description
1	Latch	1	1	1	1	Position ”1” (switch on the right): trip relay is only operational while the protection is activated Position ”0” (switch on the left) trip relay changes to latching status after trip
2	L>&I> / L>	0	0	0	0	Position ”0” (switch on the left): trip is activated by arc and current criteria Position ”1” (switch on the right) - trip is activated by light criteria alone
3	CBFP/ Fast	0	0	0	0	Position ”0” (switch on the left): output trip relays 2 and 4 serve as CBFP Position ”1” (switch on the right) output trip relays 2 and 4 serve as fast trip
4	CBFP 100/ 150 ms	1	1	1	1	Position ”0” (switch on the left): CBFP delay time 100 ms Position ”1” (switch on the right) CBFP delay time 150 ms
5	Relay matrix	1	1	0	1	Relay matrix
6	Relay matrix	0	1	1	1	Relay matrix
7	Relay matrix	0	0	0	0	Relay matrix
8	central unit/sub-unit	0	1	0	1	Position ”0” (switch on the left): central unit in central unit mode Position ”1” (switch on the right) central unit in sub-unit mode

Since VAMP 221 (1 and 3) serves as the central unit for I/O units, VAMP 221 (1 and 3) must be in the central unit operating mode.

VAMP 221 (2 and 4) must be in the sub-unit operating mode.

Current pick-up setting potentiometer settings L1/L3 and L2/I_0

L1 / L3

Potentiometer settings are used to set the light activation level for phase currents I_{L1} and I_{L3}. The setting zone is 0.5 … 6 x I_N. This current setting is separate from the I_{L2}/I_0 setting.

L2 / I_0

Potentiometer settings are used to set the light activation level for phase currents I_{L2} or earth-fault current I_0. The setting zone is 0.05 … 5 x I_N. This current setting is separate from the I_{L1}/I_{L3} setting.

NOTE! If three phase currents are connected to the central unit, both L1/L3 and L2 settings must be made.

Configuration of the current I/O unit VAM 4C and VAM 4CD (8)

SW1 switch settings

Switch	Definition	VAM4C(8) Setting	Description
1	Zone 1	0	System operating zone 1 (light information)
2	Zone 2	0	System operating zone 2 (light information)
3	Zone 3	0	System operating zone 3 (light information)
4	Zone 4	1	System operating zone 4 (light information)
5	Addr	0	Address weighting coefficient 8
6	Addr	0	Address weighting coefficient 4
7	Addr	0	Address weighting coefficient 2
8	Addr	1	Address weighting coefficient 1

VAM 4C (8) address ”1” (33)

SW2 switch settings

Switch	Definition	VAM4C(2) Setting	Description
1	Latch	1	Position ”0” (switch down): trip relay is only operational while the protection is activated Position ”1” (switch up): trip relay changes to latching status after trip
2	1A / 5A	0 *)	Position ”0” (switch down): rated secondary current of the current transformer is 1 A Position ”1” (switch up): rated secondary current of the current transformer is 5 A
3	I> out	1	Position ”0” (switch down): unit does not transmit the current criteria to other units Position ”1” (switch up): unit transmits the current criteria to other units.
4	I> in	1	Position ”0” (switch down): unit does not receive the current criteria from other units Position ”1” (switch up): unit receives the current criteria from other units.

*) As in CT

Current pick-up setting potentiometer settings L1/L3 and L2/I_0

L1 / L3

Potentiometer settings are used to set the light activation level for phase currents I_{L1} and I_{L3}. The setting zone is 0.5 … 6 x I_N. This current setting is separate from the I_{L2}/I_0 setting.

L2 / I_0

Potentiometer settings are used to set the light activation level for phase currents I_{L2} or earth-fault current I_0. The setting zone is 0.05 … 5 x I_N. This current setting is separate from the I_{L1}/I_{L3} setting.

NOTE! If three phase currents are connected to the I/O unit, both L1/L3 and L2 settings must be made.

Configuration of the light I/O unit VAM 10L and VAM 10LD (5,6,7,9,10,11,12 and 13)

SW1 switch settings

Switch	Definition	VAM10L(5,10) Setting	VAM10L(6,13) Setting	VAM10L(9,11) Setting	VAM10L(7,12) Setting	Description
1	L> ext/int	1	1	1	1	Position ”1” (switch on the right) unit does not receive the light criteria from other units Position ”0” (switch on the left): unit receives the light criteria from other units in the same protection zone
2	Latch	1	1	1	1	Position ”0” (switch on the left) trip relay is only operational while the protection is activated Position ”1” (switch on the right) trip relay changes to latching status after trip
3	L+I / L	0	0	0	0	Position ”0” (switch on the left) trip is activated by arc and current criteria Position ”1” (switch on the right) - trip is activated by light criteria alone
4	Zone 4	0	0	1	1	Address weighting coefficient 16
5	Addr	0	1	0	1	Address weighting coefficient 8
6	Addr	0	0	0	0	Address weighting coefficient 4
7	Addr	0	0	0	0	Address weighting coefficient 2
8	Addr	0	0	0	0	Address weighting coefficient 1

VAM 10L (5,10) unit address “0” (protection zone 1)

VAM 10L (6,13) unit address “8” (protection zone 2)

VAM 10L (9,11) unit address “16” (protection zone 3)

VAM 10L (7,12) unit address “24” (protection zone 4)

7.3.4. System testing

Configuration of the central unit VAMP 221 (1, 2, 3, 4)

The system is configured in INSTALL mode on central units in the central unit mode once the settings of each system component have been completed. You can verify system configuration against the physical connections in the INFO mode.

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I_N). You can monitor unit activation on the current measuring display and by the I>int indicator light.

To verify the setting value, feed the targeted start current to the current channel L2 or I_0 (for example, 3 x I_N). You can monitor unit activation on the current measuring display and by the I>int indicator light.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a fault alarm (alarm No. 18). This alarm will not prevent unit operation, however. Each unbalance alarm must be separately acknowledged in the central unit.

NOTE! Unbalance error has been removed from the software version 3.12 onwards.

Testing of the current I/O unit VAM 4C and VAM 4CD (8)

To verify the setting value, feed the targeted start current to the current channel L1 or L3 (for example, 3 x I_N). Then turn the potentiometer until the unit activates and the L1 or L3 current channel indicator light is lit.

To verify the setting value, feed the targeted start current to the current channel L2 or I_0 (for example, 3 x I_N). Then turn the potentiometer until the unit activates and the L2 or I_0 current channel indicator light is lit.

If phase current is not fed to all three phases simultaneously, the unbalance load alarm is activated. Unbalance is indicated by a blinking LED in connection with the deviating phase. The unit also sends a fault alarm to the central unit, where it must be separately acknowledged. This alarm will not prevent unit operation, however.

Testing of the light I/O unit VAM 10L and VAM 10LD (5, 6, 7, 9, 10, 11, 12, 13)

To verify the transfer of the light information, activate each sensor using a powerful light source, such as a flashlight. To verify the data transfer, check the light activation from the unit's indicator lights and central unit display.

Testing of overall system operation

Feed a test current exceeding the current limit to the current channels of the central unit and the current I/O units and provide light information for each light I/O unit (at least one light criterion per I/O unit). Verify tripping and its selectivity. **Verify the operation of the BI/O bus** by feeding overcurrent information from one system to another.

Verify the trip circuit wiring by tripping each system circuit breaker at least once using the system's output trip relay.

Fill in a testing report (see model report in the User's Manual) during the test.

Close the hard wire connection terminals opened during testing and remove temporary connections. The system is ready for commissioning.

7.4. Arc protection current measuring based on earth-fault current

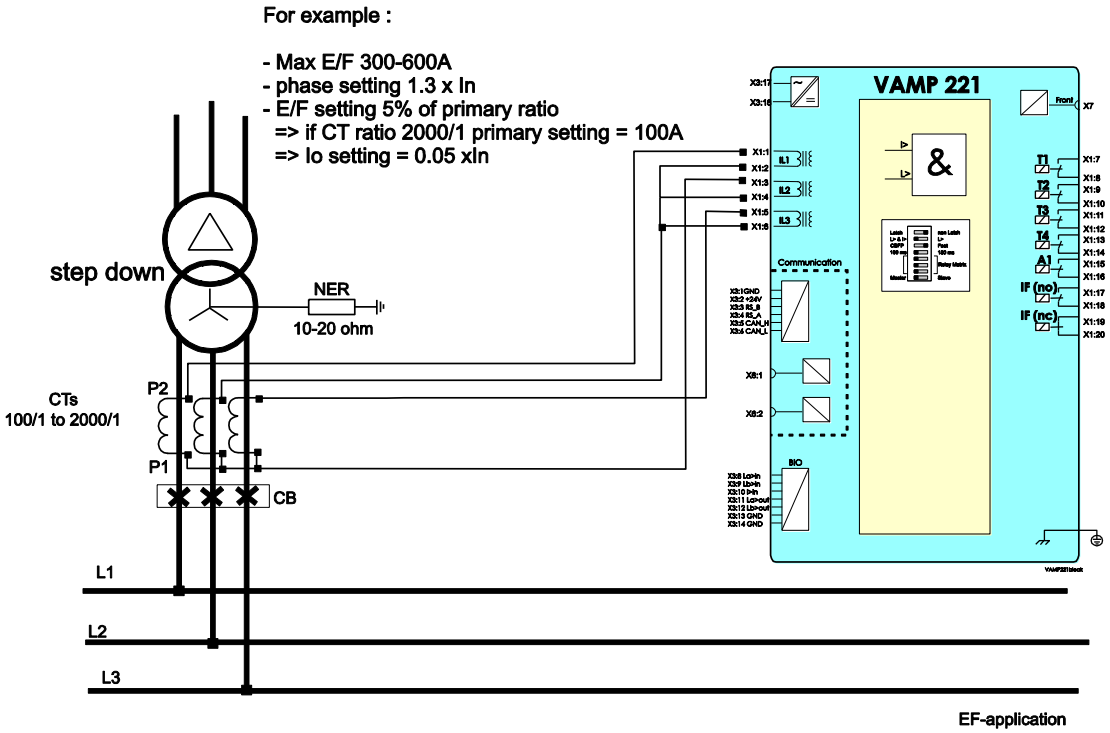


Figure 7.4-1 Arc protection current measuring based on earth-fault current

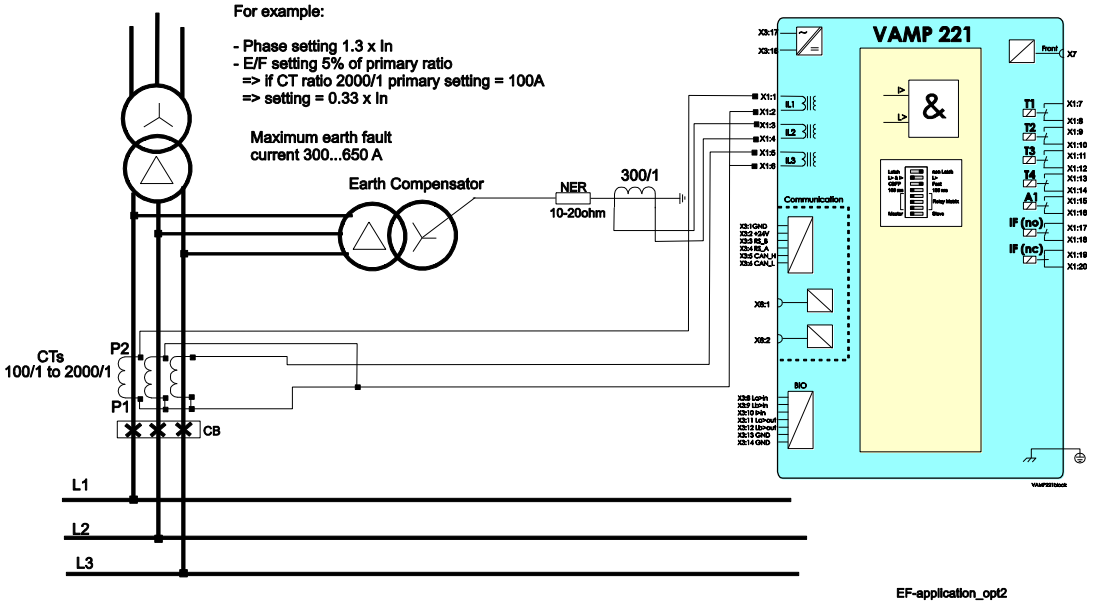


Figure 7.4-2 Arc protection current measuring based on earth-fault current

7.4.1. Functional system description

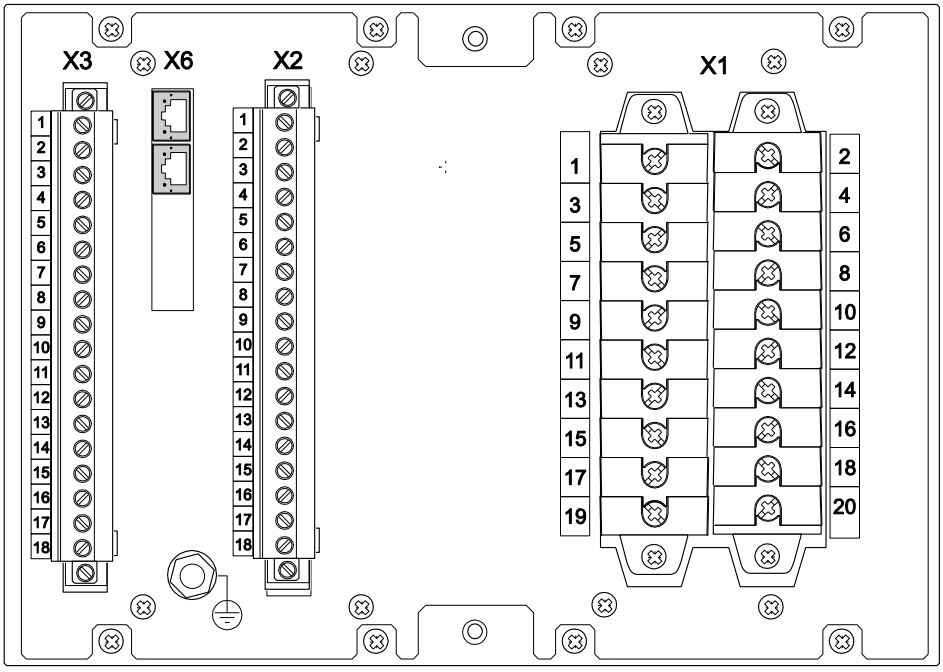
The purpose of this application example is to demonstrate the implementation of the arc protection light criteria using earth-fault current.

The earth-fault current can be measured directly from the summation connection of the instrument transformer, in which case the sum of the phase currents is wired through the L2/I_0 current measuring channel. (Figure 3.4-1)

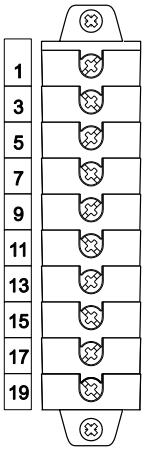
An alternative, more accurate, method is to connect a current transformer that measures earth-fault current directly to the L2/ I_0 current measuring channel.

8. Interfaces

8.1. Rear panel view

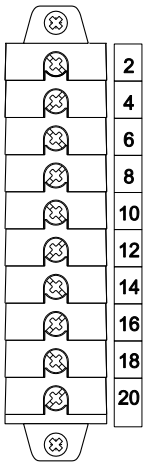


Terminal X1, left side



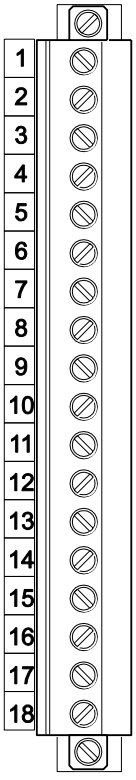
Terminal No.	Symbol	Description
X1:1	IL1 (S1)	Current input 1 (S1)
X1:3	IL2 / Io (S1)	Current input 2 (S1)
X1:5	IL3 (S1)	Current input 3 (S1)
X1:7	TRIP 1	Trip relay 1
X1:9	TRIP 2	Trip relay 1
X1:11	TRIP 3	Trip relay 1
X1:13	TRIP 4	Trip relay 1
X1:15	TRIP ALARM	Normally open trip alarm relay
X1:17	SF(NC)	Self-supervision relay, closed when Relay energized
X1:19	SF(NO)	Self-supervision relay, open when Relay energized

Terminal X1, right side



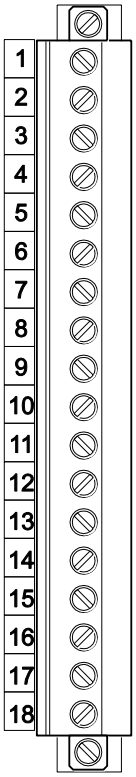
Terminal No.	Symbol	Description
X1:2	IL1 (S2)	Current input 1 (S2)
X1:4	IL2 / Io(S2)	Current input 2 (S2)
X1:6	IL3 (S2)	Current input 3 (S2)
X1:8	TRIP 1	Trip relay 1
X1:10	TRIP 2	Trip relay 1
X1:12	TRIP 3	Trip relay 1
X1:14	TRIP 4	Trip relay 1
X1:16	TRIP ALARM	Normally open trip alarm relay
X1:18	SF(NC)	Self-supervision relay, closed when Relay energized
X1:20	SF(NO)	Self-supervision relay, open when Relay energized

Terminal X2



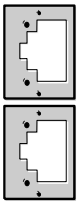
Terminal No.	Symbol	Description
X2:1	Power LED	Power LED control (Unit 1)
X2:2	GND	Power + Trip LED GND (Unit 1)
X2:3	Trip LED	Trip LED control (Unit 1)
X2:4		
X2:5	1A+	Trip output for VAM 3QD (Trip group 1)
X2:6	1A-	Trip output for VAM 3QD (Trip group 1)
X2:7	1B+	Trip output for VAM 3QD (Trip group 1)
X2:8	1B-	Trip output for VAM 3QD (Trip group 1)
X2:9		
X2:10		
X2:11	Power LED	Power LED control (Unit 2)
X2:12	GND	Power + Trip LED GND (Unit 2)
X2:13	Trip LED	Trip LED control (Unit 2)
X2:14		
X2:15	2A+	Trip output for VAM 3QD (Trip group 2)
X2:16	2A-	Trip output for VAM 3QD (Trip group 2)
X2:17	2B+	Trip output for VAM 3QD (Trip group 2)
X2:18	2B-	Trip output for VAM 3QD (Trip group 2)

Terminal X3



Terminal No.	Symbol	Description
X3:1	GND	I/O unit ground potential
X3:2	+24V	I/O unit operating voltage
X3:3	RS_B	Data bus
X3:4	RS_A	Data bus
X3:5	CAN_H	Data bus
X3:6	CAN_L	Data bus
X3:7		
X3:8	La> in	Arc input, tripping group 1
X3:9	Lb> in	Arc input, tripping group 2
X3:10	I> in/out	Current input
X3:11	La> out	Arc output, tripping group 1
X3:12	Lb> out	Arc output, tripping group 2
X3:13	GND	
X3:14	GND	
X3:15		
X3:16		
X3:17	Us	Operating voltage
X3:18	Us	Operating voltage

Terminal X6



Terminal No.	Description
X6:1	Modular cable terminal 1
X6:2	Modular cable terminal 2

8.2. Analogue measurements

VAMP 221:

3 current measuring channels 1/5A

VAM 4C and VAM 4CD:

3 current measuring channels 1/5A

VAM 10L and VAM 10LD:

10 light measuring channels for point sensors

VAM 3L and VAM 3LX:

3 light measuring channels for fibre loop sensors (adjustable light sensitivity in VAM 3LX model)

8.3. Digital inputs (BI/O bus)

The following BI/O interfaces are included in the standard VAMP 221 delivery:

La>in	X3-8	Arc input, tripping group 1
Lb>in	X3-9	Arc input, tripping group 2
Ib> in/out	X3-10	Overcurrent input/output
La> out	X3-11	Arc output, tripping group 1
Lb> out	X3-12	Arc output, tripping group 2
GND	X3-13, X3-14	Grounding for all BI/O signals

The following BI/O interfaces are included in standard VAM 10L / VAM 10LD and VAM 3L / VAM 3LX deliveries:

I>in	X2-8	Zone shift, 24-48 VDC
GND	X2-7	Current input earth
Trip out	X2-10	Trip output, 24 VDC
GND	X2-9	Trip output earth

The following BI/O connections are included in the standard VAM 4C / VAM 4CD delivery:

L>in	X2-8	Arc input, 24-48 VDC
GND	X2-7	Arc input earth
I>out	X2-10	Current output, 24 VDC
GND	X2-9	Current output earth

8.4. Auxiliary power supply

Connect the auxiliary supply voltage to the U_s input, terminals X3-17 X3-18.

8.5. Output relays

8.5.1. VAMP 221

Connect the circuit breaker's trip circuits to the following terminals (a maximum of four separate trip outputs in two separate groups):

TRIP1:	X1-7, X1-8	(fast, group 1)
TRIP2:	X1-9, X1-10	(fast/CBFP, group 1)
TRIP3:	X1-11, X1-12	(fast, group 2)
TRIP4:	X1-13, X1-14	(fast/CBFP, group 2)

Connect the self-supervision alarm output to an IF change-over contact, either terminals X1-17, X1-18 (normally open) or X1-19, X1-20 (normally closed).

During normal system operation (no internal fault) and with the auxiliary power supply connected, the terminal X1-17, X1-18 are closed and X1-19, X1-20 are open.

Connect the trip alarm output to the closing terminals X1-15, X1-16.

8.5.2. VAM 10L / VAM 10LD, VAM 3L / VAM 3LX and VAM 4C / VAM 4CD

Connect the circuit breaker's trip circuit to the following terminals:

TRIP1:	X2-15, X2-16	(fast)

The output trip relay of the arc I/O units (VAM 10L and VAM 3L / VAM 3LX) operates during faults in its own zone. In the current I/O unit (VAM 4C), select the protection zone controlling the I/O unit using the programming switches.

8.5.3. VAM 12L / VAM 12LD

Connect each output relay to corresponding breaker.

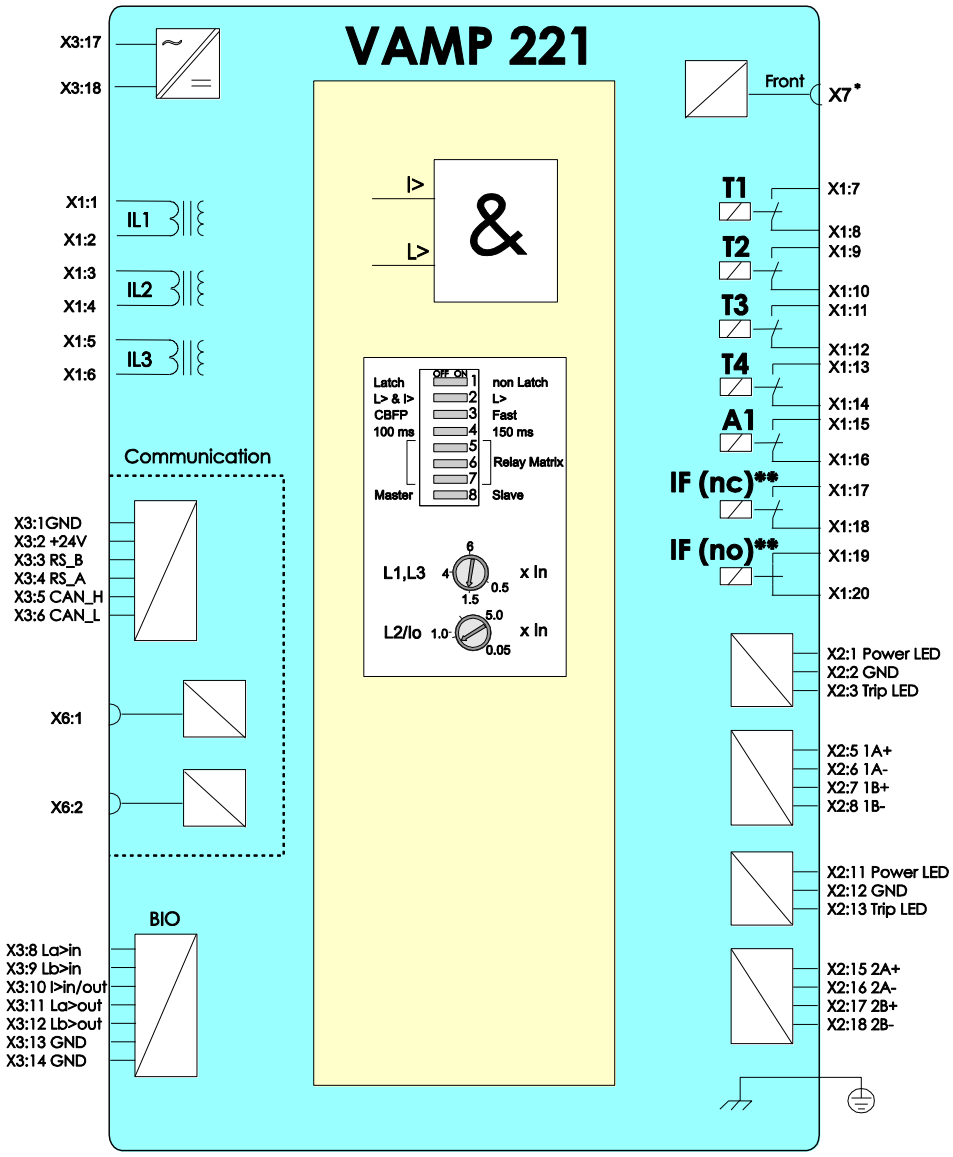
Sensor channel 1 controls Trip output 1 (X2-15, X2-16)

Sensor channel 2 controls Trip output 2 (X2-11, X2-12)

Sensor channel 3 controls Trip output 3 (X2-8, X2-9)

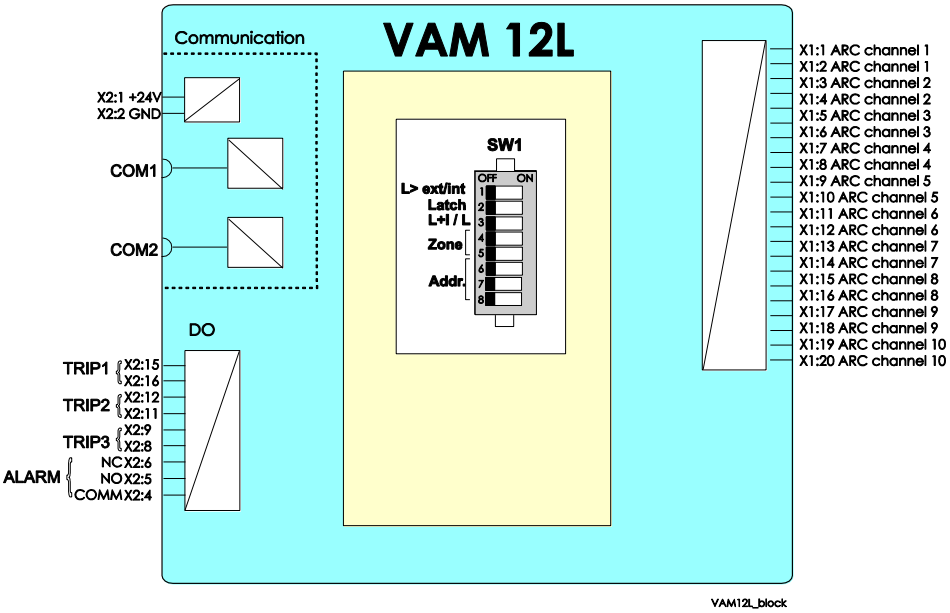
8.6. Block diagram

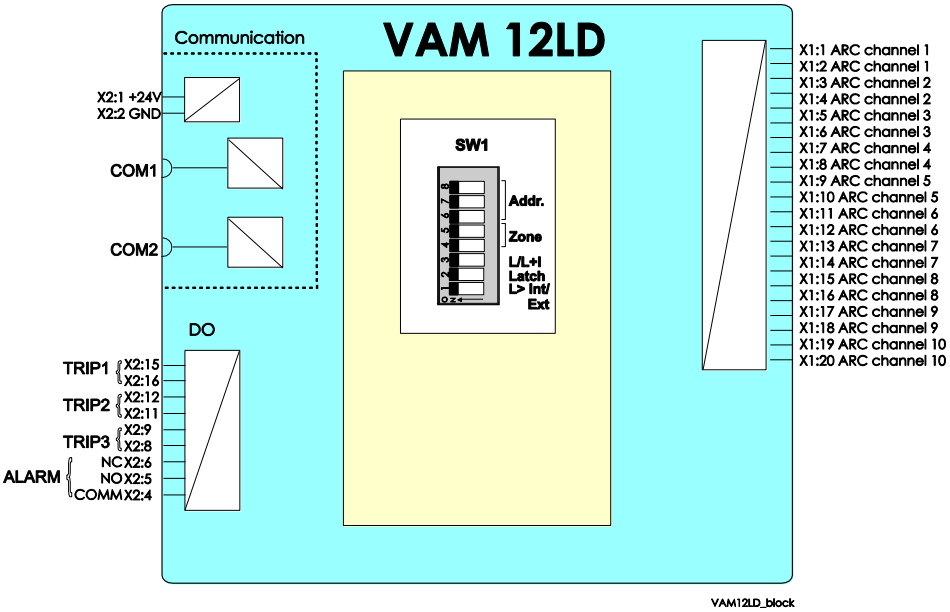
8.6.1. VAMP 221



*) Connector X7 is reserved only for productio purposes
**)When energized and no internal faults

8.6.2. VAM 12L and VAM 12LD





VAM 12L is primary design for selective feeder trip applications. The unit comprises 3 electromechanical trip normally open contacts and one trip alarm change over contact.

The unit has 10 ARC sensor inputs. Tree sensors (of the ten) inputs are dedicated, and are controlling their own trip relay. The unit is ideal for selective trip of cable compartment in case of an ARC fault. VAM 12L can selectively handle 3 feeders. The rest of the sensors can then supervise the busbar and breaker compartments and will operate in the zone selected by the unit address switches.

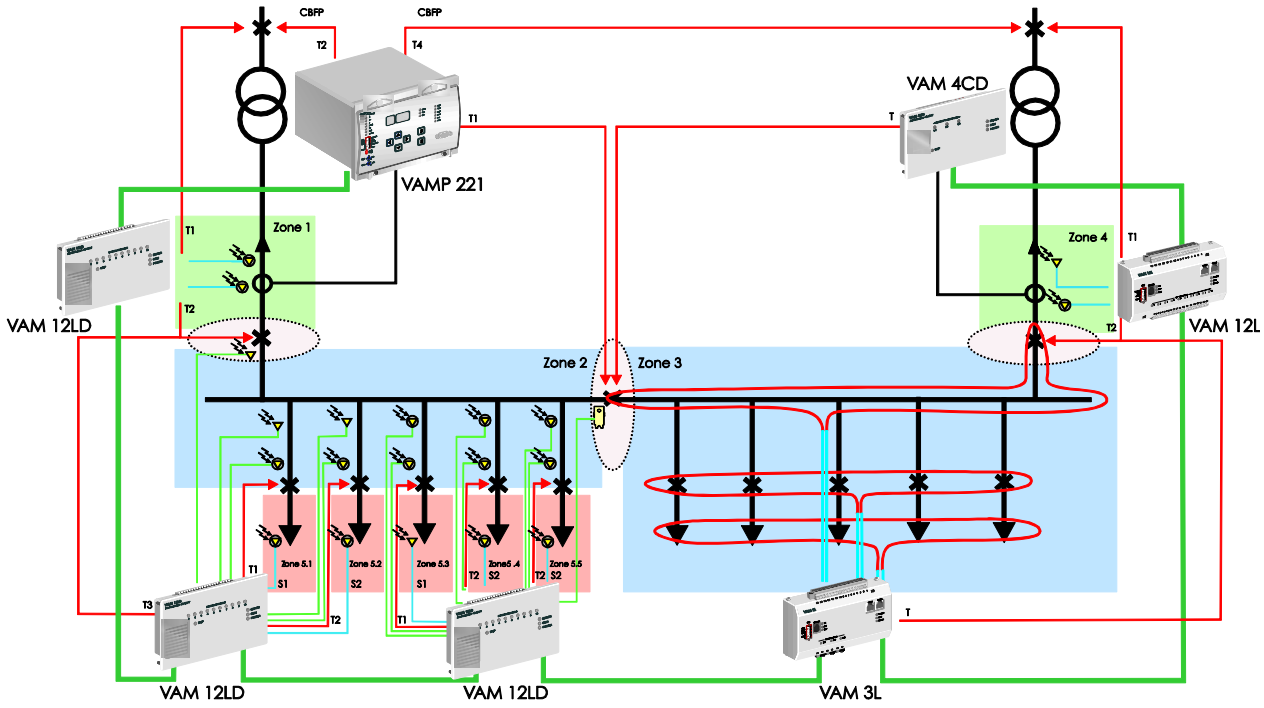


Figure 8.6.2-1 Arc scheme with I/O units

Connections

The VAM12L arc protection unit has 10 sensor channel inputs of which the three first sensor (1, 2 and 3) have dedicated trip outputs (T1, T2 and T3). Sensors 4 to 10 are part of the sensors scheme of the 221 and are operating in the zone selected by the dipswitch. The unit is receiving I> (over-current) information from VAM4C/CD or VAMP221 units through the com connection. In opposite to the VAM 10L/LD, 3L and 4C/CD the 12L/LD unit have no BI or BO connection. Also the rs485 and can connection at X2 has been removed and replaced by the DO connections

By setting L>int/ext to ext mode all 3 trip outputs will trip for a fault in zone and will hence also isolate outgoing feeders for fault in busbar compartment

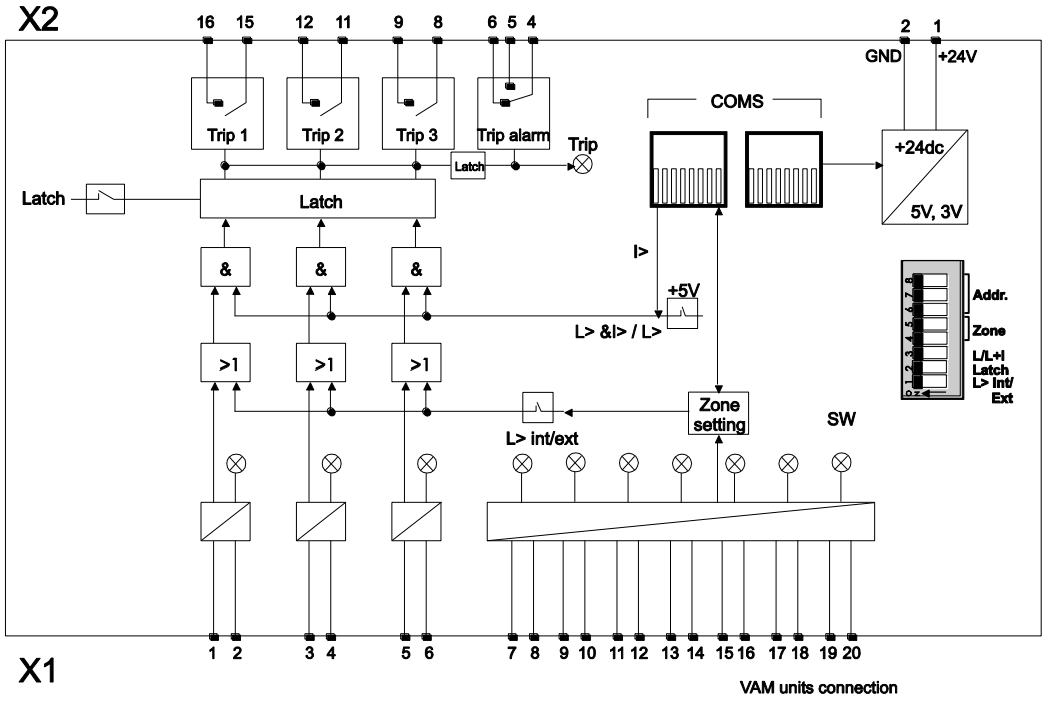
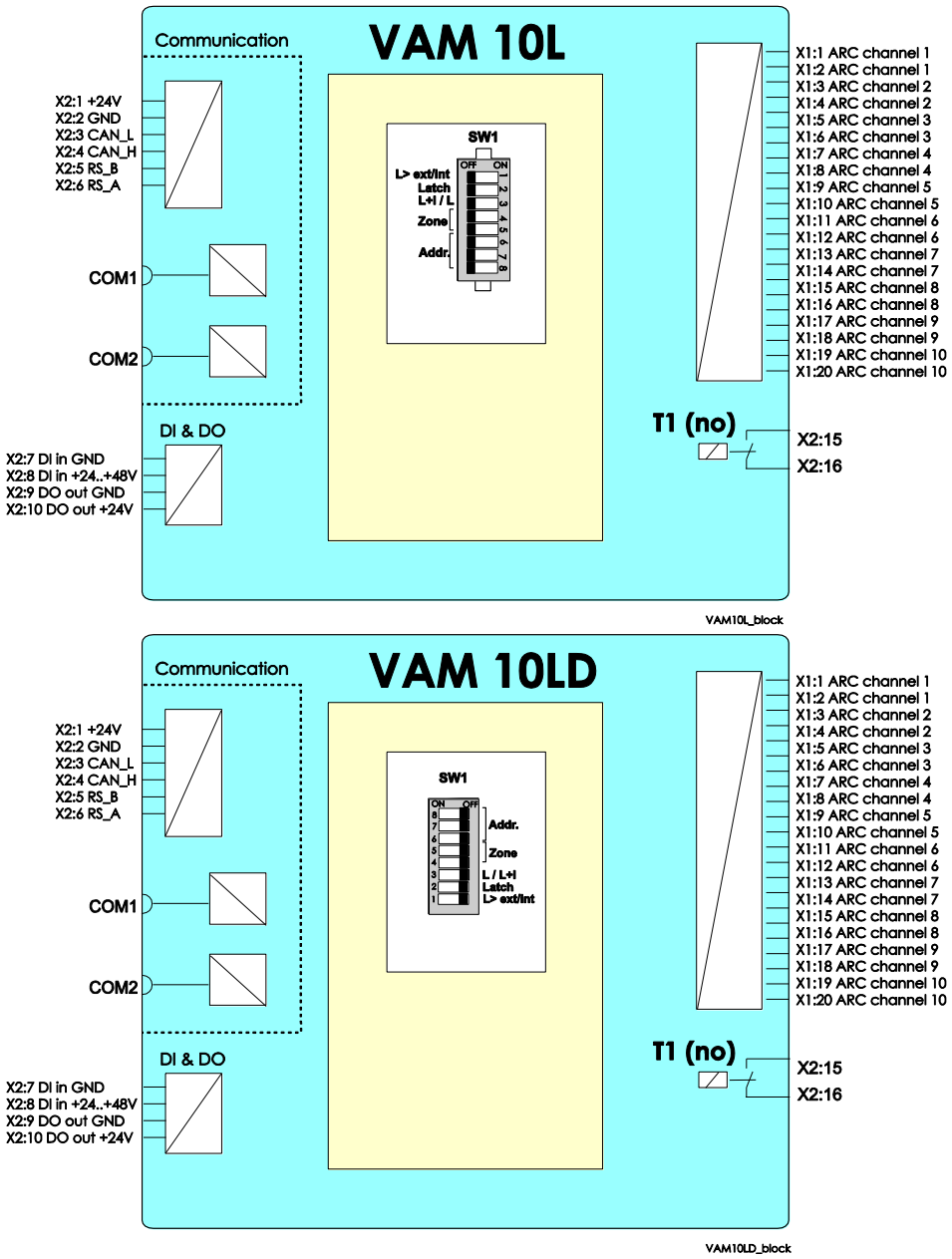


Figure 8.6.2-2 VAM 12L / VAM 12LD block diagram

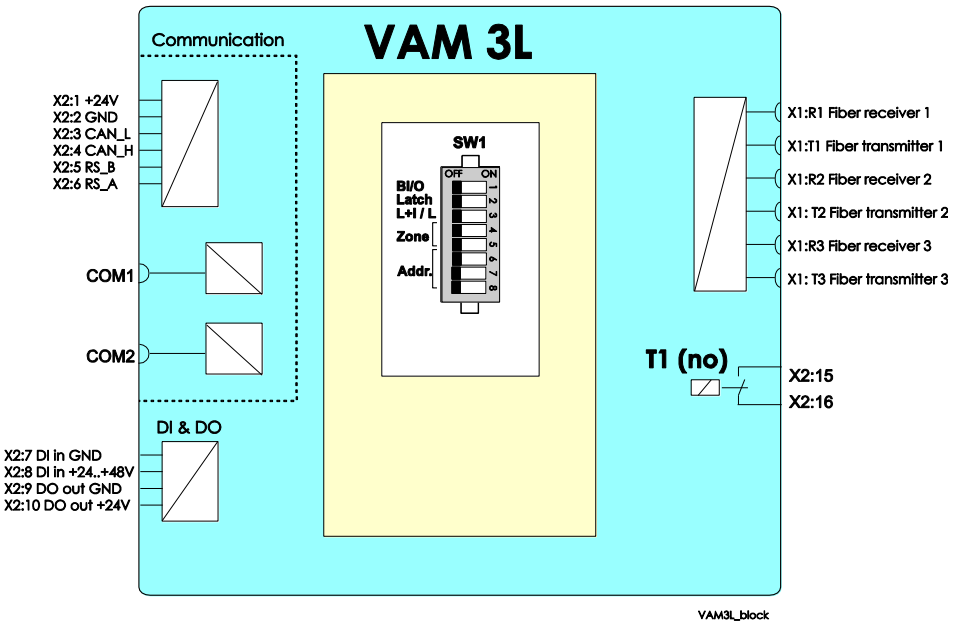
Door mounted I/O units

The VAM I/O units with the letter D in the type designations VAM 4CD, VAM 10LD and VAM 12LD are door mounted versions for the corresponding VAM 4C, VAM 10L and VAM 12 L units. The functionality is exactly the same.

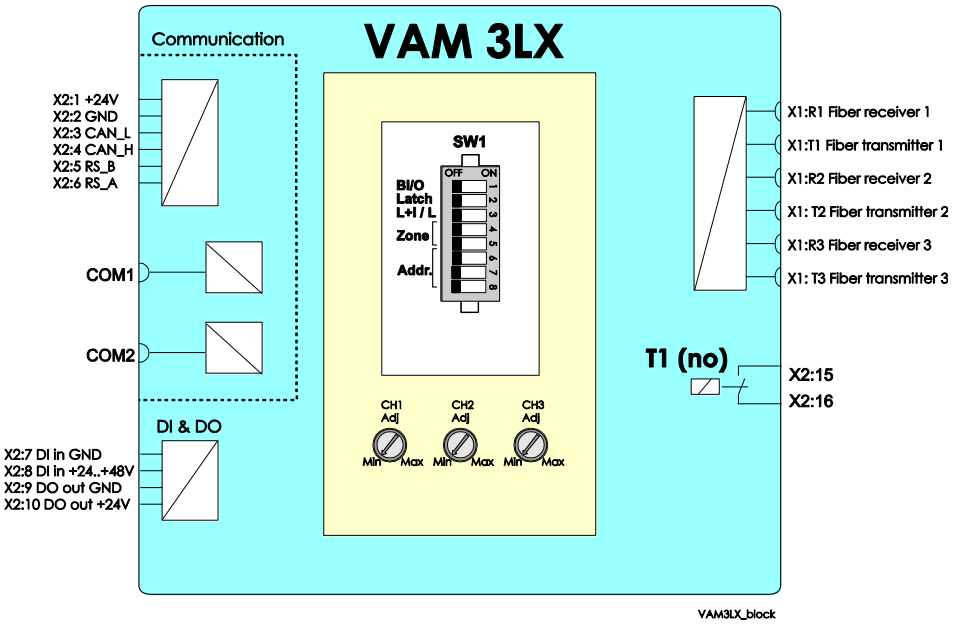
8.6.3. VAM 10L and VAM 10LD



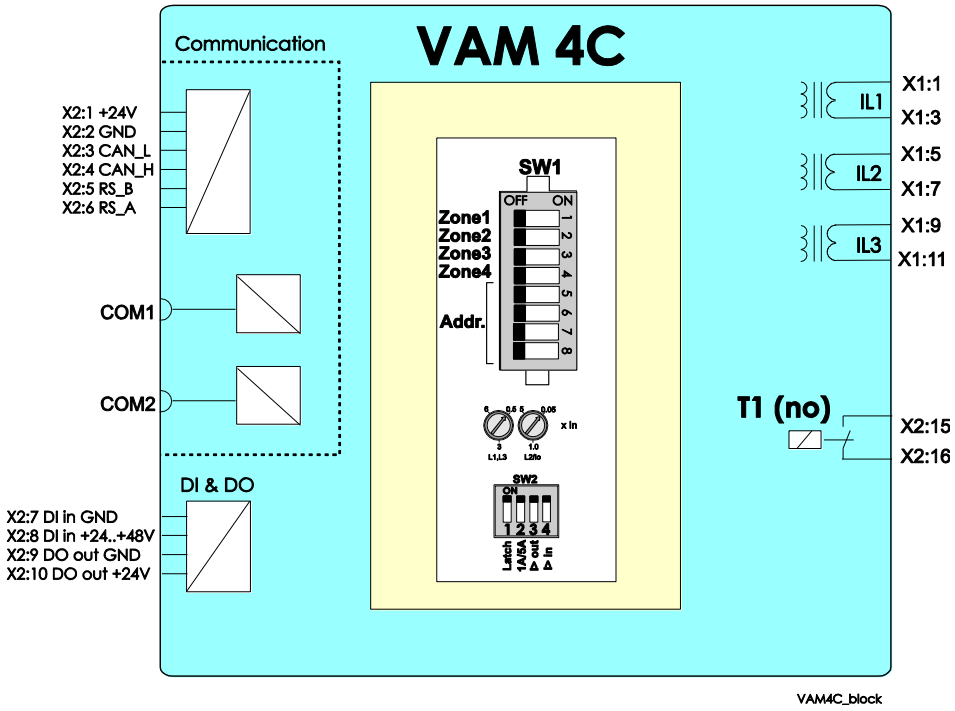
8.6.4. VAM 3L

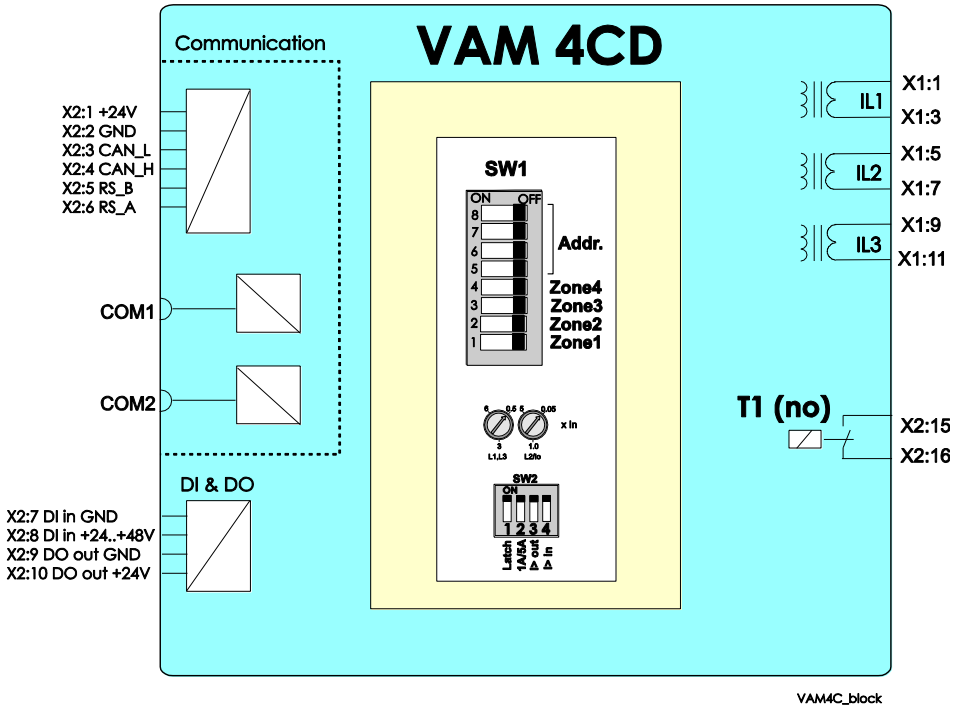


8.6.5. VAM 3LX

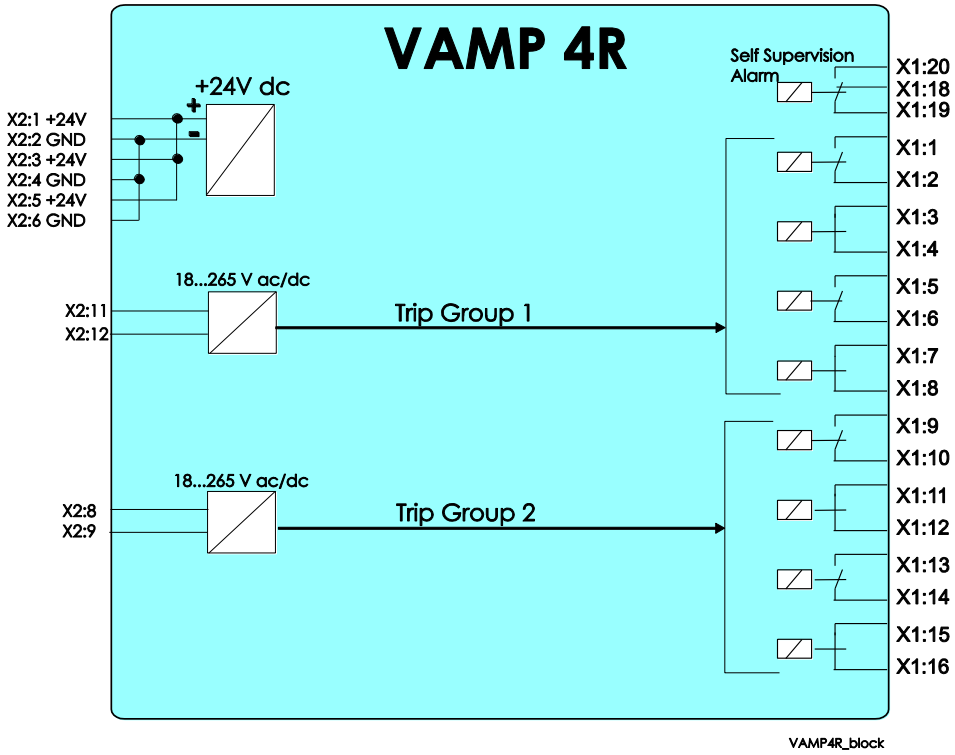


8.6.6. VAM 4C / VAM 4CD

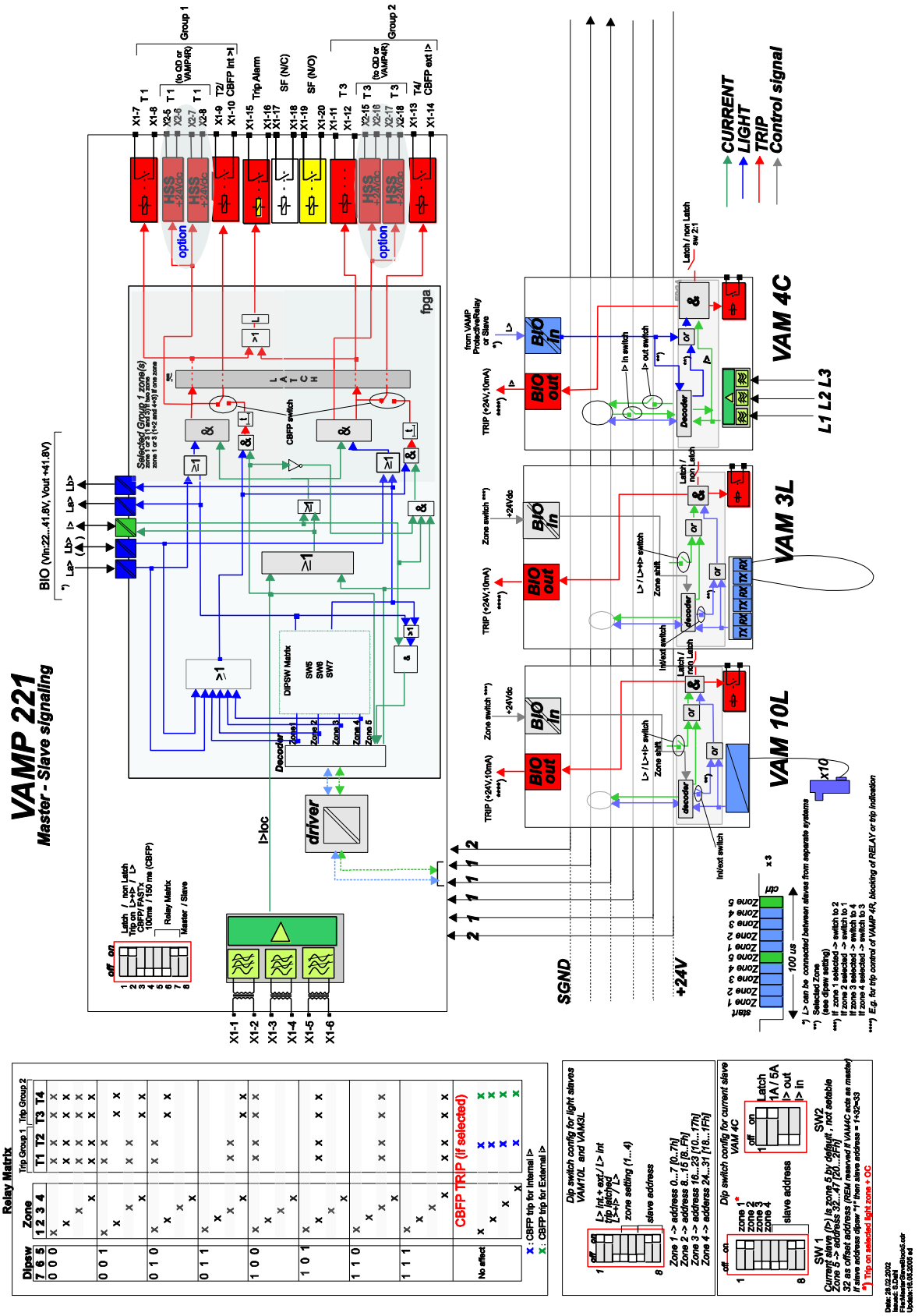




8.6.7. VAMP 4R

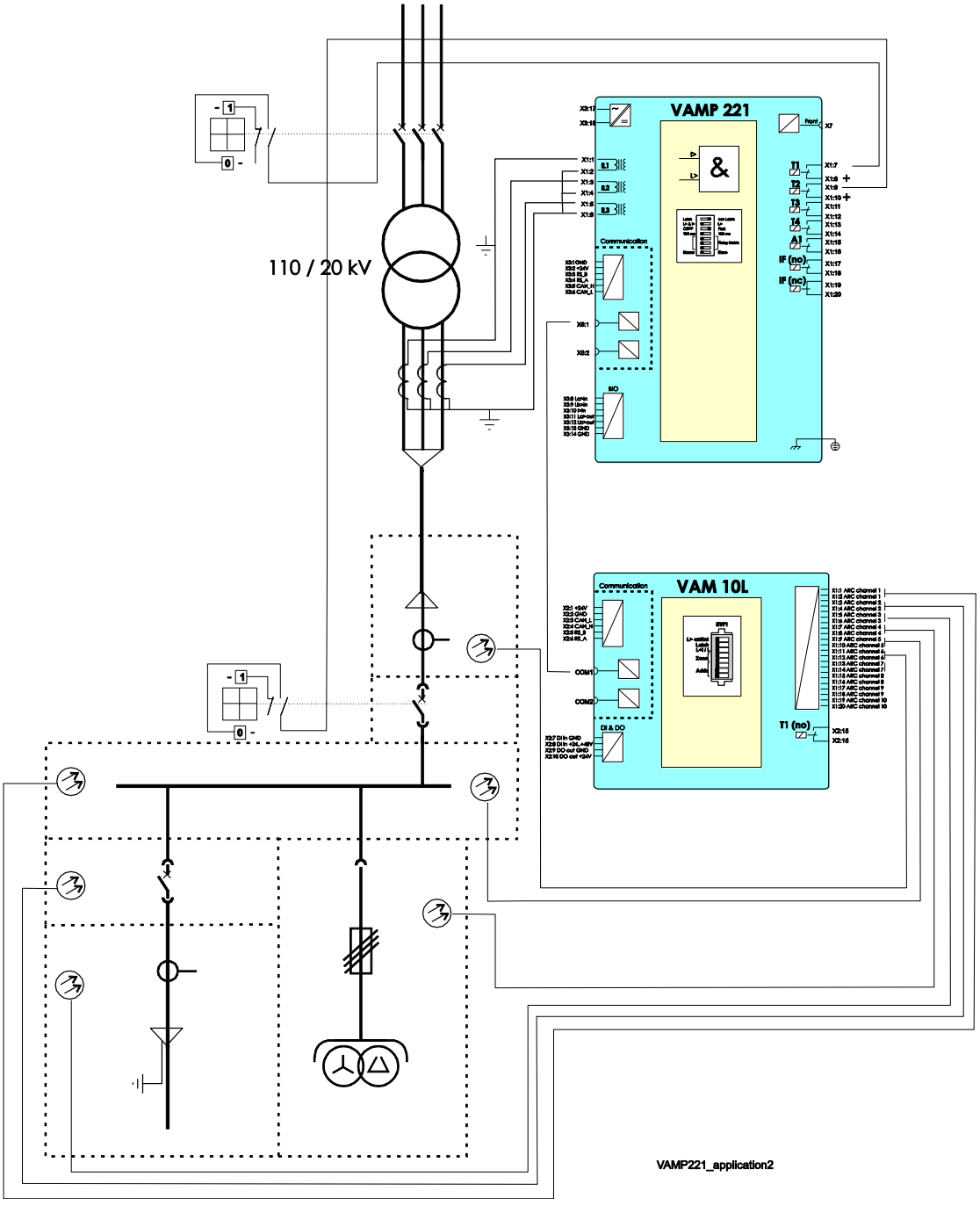

VAMP 4R
+24V dc
X2:1 +24V
X2:2 GND
X2:3 +24V
X2:4 GND
X2:5 +24V
X2:6 GND
18...265 V ac/dc
X2:11
X2:12
Trip Group 1
18...265 V ac/dc
X2:8
X2:9
Trip Group 2
Self Supervision
Alarm
X1:20
X1:18
X1:19
X1:1
X1:2
X1:3
X1:4
X1:5
X1:6
X1:7
X1:8
X1:9
X1:10
X1:11
X1:12
X1:13
X1:14
X1:15
X1:16
VAMP4R_block

8.6.8. VAMP 221 signaling diagram

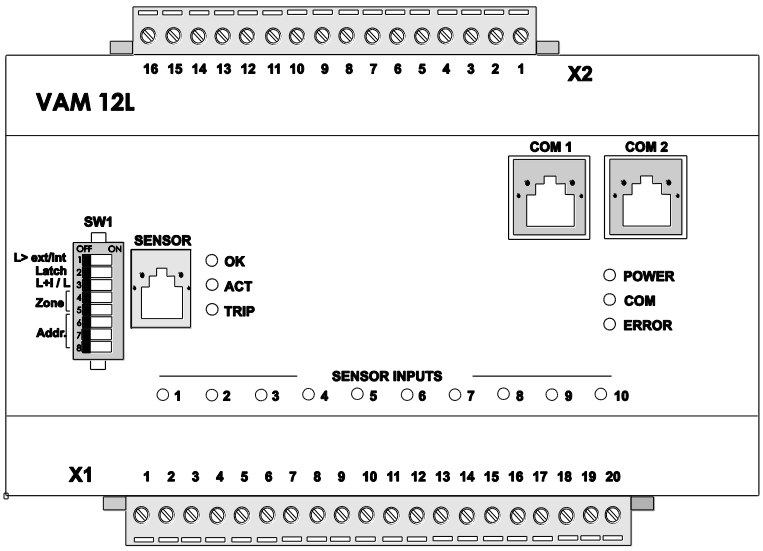


8.7. Connection examples

8.7.1. VAMP 221



8.7.2. VAM 12L

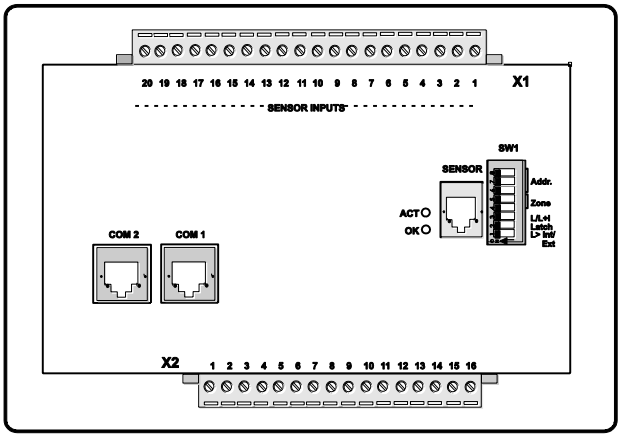


VAM 12L conn

X1-1,2:	arc sensor channel 1		
X1-3,4:	arc sensor channel 2		
X1-5,6:	arc sensor channel 3		
X1-7,8:	arc sensor channel 4		
X1-9,10:	arc sensor channel 5		
X1-11,12:	arc sensor channel 6		
X1-13,14:	arc sensor channel 7		
X1-15,16:	arc sensor channel 8		
X1-17,18:	arc sensor channel 9		
X1-19,20:	arc sensor channel 10		
X2-1:	+24v supply from masterunit or external power supply		
X2-2:	GND		
X2-3:			
X2-4:	COM	Alarm	
X2-5:	NO		
X2-6:	NC		
X2-7:			
X2-8:	Trip relay 3 (NO)		
X2-9:	Trip relay 3 (NO)		
X2-10:			
X2-11:	Trip relay 2 (NO)		
X2-12:	Trip relay 2 (NO)		
X2-13:			
X2-14:			
X2-15:	Trip relay 1 (NO)		
X2-16:	Trip relay 1 (NO)		

Figure 8.7.2-1 VAM 12L interfaces

8.7.3. VAM 12LD

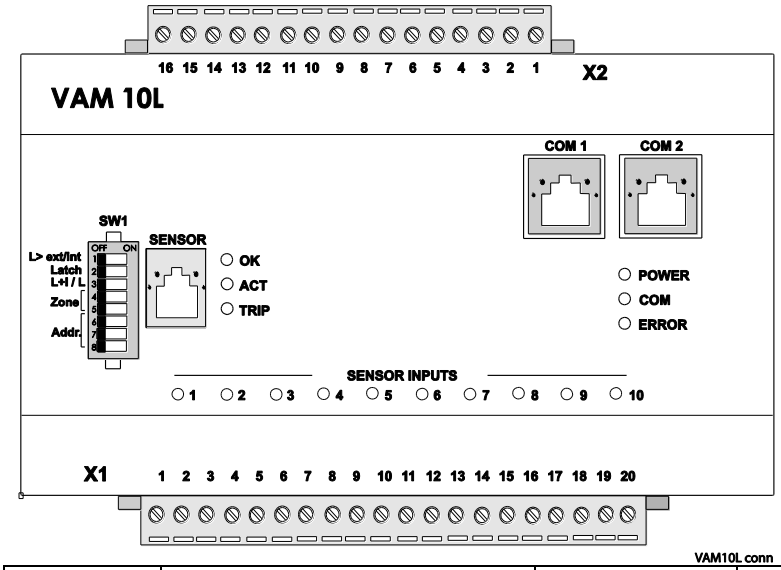


VAM12LD conn

X1-1,2:	arc sensor channel 1		
X1-3,4:	arc sensor channel 2		
X1-5,6:	arc sensor channel 3		
X1-7,8:	arc sensor channel 4		
X1-9,10:	arc sensor channel 5		
X1-11,12:	arc sensor channel 6		
X1-13,14:	arc sensor channel 7		
X1-15,16:	arc sensor channel 8		
X1-17,18:	arc sensor channel 9		
X1-19,20:	arc sensor channel 10		
X2-1:	+24v supply from masterunit or external power supply		
X2-2:	GND		
X2-3:			
X2-4:	COM	Alarm	
X2-5:	NO		
X2-6:	NC		
X2-7:			
X2-8:	Trip relay 3 (NO)		
X2-9:	Trip relay 3 (NO)		
X2-10:			
X2-11:	Trip relay 2 (NO)		
X2-12:	Trip relay 2 (NO)		
X2-13:			
X2-14:			
X2-15:	Trip relay 1 (NO)		
X2-16:	Trip relay 1 (NO)		

Figure 8.7.3-1 VAM 12LD interfaces

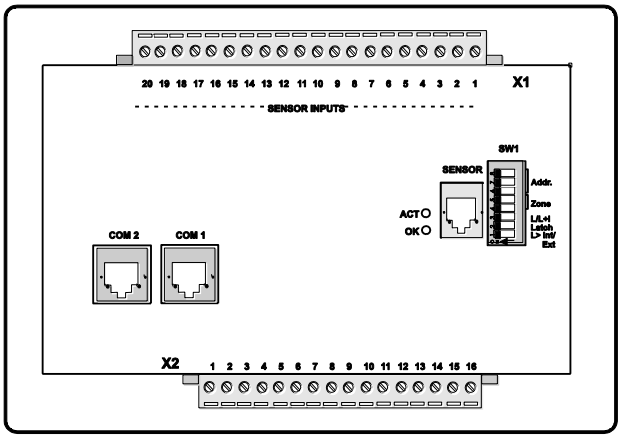
8.7.4. VAM 10L



X1-1,2:	arc sensor channel 1		
X1-3,4:	arc sensor channel 2		
X1-5,6:	arc sensor channel 3		
X1-7,8:	arc sensor channel 4		
X1-9,10:	arc sensor channel 5		
X1-11,12:	arc sensor channel 6		
X1-13,14:	arc sensor channel 7		
X1-15,16:	arc sensor channel 8		
X1-17,18:	arc sensor channel 9		
X1-19,20:	arc sensor channel 10		
X2-1:	+24V supply from masterunit or external power supply		=COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, I>)	
X2-4:	CAN-H		
X2-5:	Serial B	Master slave com	
X2-6:	Serial A		
X2-7:	DI GND	Zone change (1 -> 2; 2 ->1; 3 -> 4; 4 -> 3)	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND	Trip information (DI & DO)	
X2-10:	DO +24Vdc		
X2-11:	+ Temp sensor	Not in use	
X2-12:	- Temp sensor		
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure 8.7.4-1 VAM 10L interfaces

8.7.5. VAM 10LD

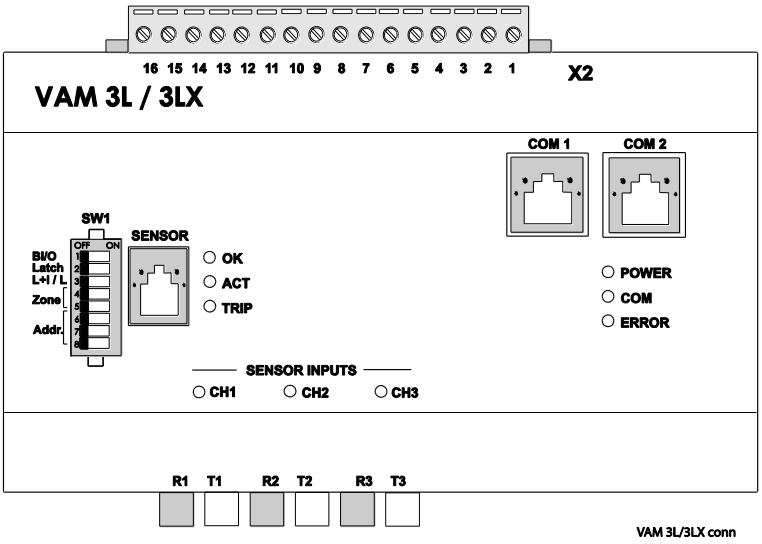


VAM10LD conn

X1-1,2:	arc sensor channel 1		
X1-3,4:	arc sensor channel 2		
X1-5,6:	arc sensor channel 3		
X1-7,8:	arc sensor channel 4		
X1-9,10:	arc sensor channel 5		
X1-11,12:	arc sensor channel 6		
X1-13,14:	arc sensor channel 7		
X1-15,16:	arc sensor channel 8		
X1-17,18:	arc sensor channel 9		
X1-19,20:	arc sensor channel 10		
X2-1:	+24V supply from masterunit or external power supply		=COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, I>)	
X2-4:	CAN-H		
X2-5:	Serial B	Master slave com	
X2-6:	Serial A		
X2-7:	DI GND	Zone change (1 -> 2; 2 ->1; 3 -> 4; 4 -> 3)	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND	Trip information (DI & DO)	
X2-10:	DO +24Vdc		
X2-11:	+ Temp sensor	Not in use	
X2-12:	- Temp sensor		
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure 8.7.5-1 VAM 10LD interfaces

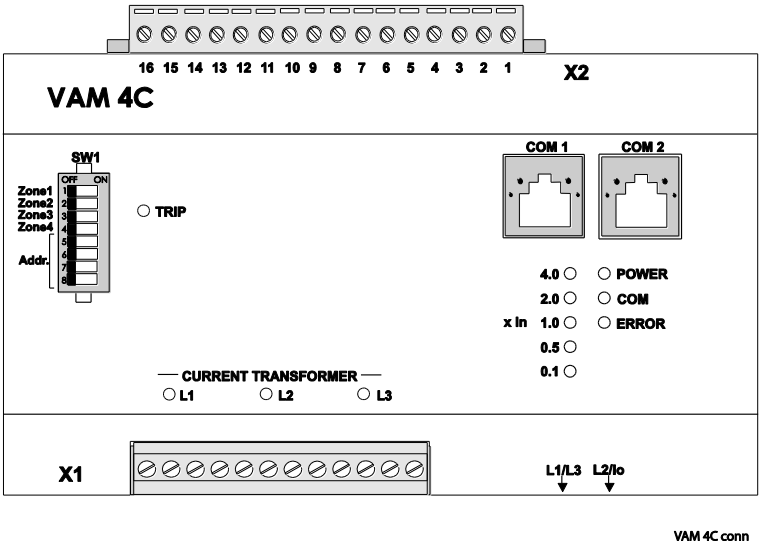
8.7.6. VAM 3L / VAM 3LX



X1-R1:	Fiber receiver connection	Channel 1	
X1-T1:	Fiber transmitter connection		
X1-R2:	Fiber receiver connection	Channel 2	
X1-T2:	Fiber transmitter connection		
X1-R3:	Fiber receiver connection	Channel 3	
X1-T3:	Fiber transmitter connection		
X2-1:	+24V supply from master unit or external power supply		= COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, I>)	
X2-4:	CAN-H		
X2-5:	Serial B	master slave com	
X2-6:	Serial A		
X2-7:	DI GND	Zone change (1 -> 2; 2 -> 1; 3 -> 4; 4 -> 3)	
X2-8	DI (24-48Vdc)		
X2-9:	DO GND	Trip information (DI&DO)	
X2-10:	DO +24Vdc		
X2-11:	+ Temp sensor	Not in use	
X2-12:	- Temp sensor		
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure 4.7.3 Example of VAM 3L interfaces

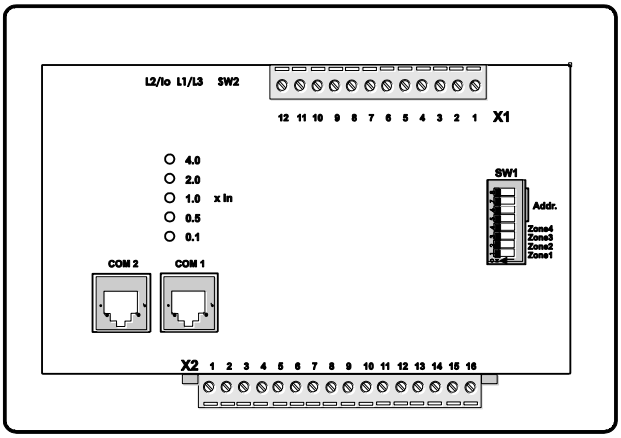
8.7.7. VAM 4C



X1-1,3:	Current input IL1		
X1-5,7:	Current input IL2 / Io		
X1-9,11.	Current input IL3		
X2-1:	+24V supply from master unit or external power supply		= COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, I>)	
X2-4:	CAN-H		
X2-5:	Serial B	master slave com	
X2-6:	Serial A		
X2-7:	DI GND	L>	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND	TRIP	
X2-10:	DO +24Vdc		
X2-11:			
X2-12:			
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure 8.7.7-1. VAM 4C interfaces

8.7.8. VAM 4CD



VAM4CD conn

X1-1,3:	Current input IL1		
X1-5,7:	Current input IL2 / Io		
X1-9,11.	Current input IL3		
X2-1:	+24V supply from master unit or external power supply		= COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, I>)	
X2-4:	CAN-H		
X2-5:	Serial B	master slave com	
X2-6:	Serial A		
X2-7:	DI GND	L>	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND	TRIP	
X2-10:	DO +24Vdc		
X2-11:			
X2-12:			
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure 8.7.8-1 VAM 4CD interfaces

9. Technical data

9.1. Connections

9.1.1. Measuring circuits

VAMP 221

Rated current L1 / L3 - current measuring zone - thermal withstand capability - power consumption	1 or 5 A (optional) 50/60Hz 0 … 6 A (0 … 6* I_N [I_N =1A]); 0 … 30 A (0 … 6*I_N[I_N =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Rated current L2 / I_0 - current measuring zone - thermal withstand capability - power consumption	1 or 5 A (optional) 50/60Hz 0…6 A (0…6*I_N [I_N =1A]); 0…30 A (0…6* I_N [I_N =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Terminal: - single or multi-strand wire	Maximum cross-section area of wire 4 mm^2 (10-12 AWG)

VAM 12L, VAM 12LD, VAM 10L, VAM 10LD

Sensor connections	10 arc sensors (type VA 1 DA or VA 1 EH) 1 portable arc sensor (type VA 1 DP)
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAM 3L

Sensor connections	3 fibre loop sensors (type ARC-SLx) 1 portable arc sensor (type VA 1 DP)

VAM 3LX

Sensor connections	3 fibre loop sensors (type ARC-SLx) - sensitivity adjust range compared to 3L 0,5 (max) … 1,5 (min) 1 portable arc sensor (type VA 1 DP)

VAM 4C, VAM 4CD

Rated current L1 / L3 - current measuring zone - thermal withstand capability - power consumption	1 or 5 A (optional) 50/60Hz 0 … 6 A (0 … 6*I_N [I_N =1A]); 0 … 30 A (0 … 6* I_N [I_N =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Rated current L2 / I_0 - current measuring zone - thermal withstand capability - power consumption	1 or 5 A (optional) 50/60Hz 0 … 6 A (0 … 6*I_N [I_N =1A]); 0 … 30 A (0 … 6* I_N [I_N =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Terminal: - single or multi-strand wire	Maximum cross-section area of wire 4 mm^2 (10-12 AWG)

9.1.2. Auxiliary power supply

VAMP 221

Rated voltage U_{AUX}	48-265 V ac/dc 110/120/220/240 VAC 50/60Hz 48/60/110/125/220 V dc
Power consumption	< 7 W (in normal mode) < 10 W (output relays activated)
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAM 12L, VAM 12LD, VAM 10L, VAM 10LD, VAM 3L, VAM 3LX, VAM 4C, VAM 4CD

Rated voltage U_{AUX}	24 V dc
Power consumption	< 1 W (in normal mode) < 1.5 W (output relays activated)
Terminal: - Phoenix MVSTBW or similar (RJ 45 when supply from central unit)	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAR 4CE

Rated voltage U_{AUX}	24 V dc
Power consumption	< 0.5 W (in normal mode) < 4.5 W (output relays activated)
Terminal: - fixed terminal	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAMP 4R

Rated voltage U_{AUX}	24 V dc
Current consumption - one relay group activated - both relay groups activated	20 mA stby 80 mA 180 mA

VA 1 DA, VA 1 EH, VA 1 DP

Rated voltage U_{AUX}	12 V dc (from I/O unit)
Power consumption	< 35 mW (in normal mode) < 450 mW (activated)

9.1.3. Digital inputs (BI/O bus)

VAMP 221

Number of inputs	2 pcs L> in (La> tripping group 1, Lb> tripping group 2) 2 pcs I> out Ia> tripping group 1, Ib> tripping group 2) 1 pcs I> in/out
Internal operating voltage	48 V dc
Load capacity (max.)	5 mA
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

No digital inputs available in VAM 12L and VAM 12LD

VAM 10L, VAM 10LD, VAM 3L, VAM 3LX

Number of inputs	1 pcs I> in 1 arc fault trip out
Internal operating voltage	24…48 V dc (BIO in) 24 V dc (BIO out)
Load capacity (max.)	5 mA
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAM 4C

Number of inputs	1 pcs L> in 1 pcs I> out
Internal operating voltage	24…48 V dc (BIO in) 24 V dc (BIO out)
Load capacity (max.)	5 mA
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAMP 4R

Operating voltage	18…265 V ac/dc
Current consumption	2 mA

9.1.4. Trip contacts

VAMP 221

Number of contacts	4 closing contacts (relays T1-T4)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s Make and carry for 3s	30 A 15 A
Breaking capacity, dc(L/R=40 ms) At 48 V dc: At 110 V dc: At 220 V dc:	 1 A 0.44 A 0.22 A
Relay material	AgNi 90/10
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire: 2.5 mm^2 (13-14 AWG)

VAM 12L, VAM 12LD, VAM 10L, VAM 10LD, VAM 3L, VAM 3LX, VAM 4C, VAM 4CD

Number of contacts for VAM 10L, VAM 10LD, VAM 3L, VAM 3LX, VAM 4C, VAM 4CD	1 closing contact (relay T1)
Number of contacts for VAM 12L, VAM 12LD	3 closing contacts (relay T1)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s Make and carry for 3s	30 A 15 A
Breaking capacity, dc(L/R=40 ms) At 48 V dc: At 110 V dc: At 220 V dc:	 1 A 0.44 A 0.22 A
Relay material	AgNi 90/10
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAR 4CE

Number of contacts	4 closing contacts (relays T1-T4)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s Make and carry for 3s	30 A 15 A
Breaking capacity, dc(L/R=40 ms) At 48 V dc: At 110 V dc: At 220 V dc:	 5 A 3 A 1 A
Relay material	AgNi 90/10
Terminal:	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

VAMP 4R

4N/O / 4N/C rated voltage	250V ac/dc
Continuous withstand capacity	5A
Make and carry for 0.5s Make and carry for 3s	30A 15A
N/O breaking capacity dc (L/R=40ms) At 48 V dc At 110 V dc At 220 V dc	 1A 0.44A 0.22A
Contact material	AgNi 90/10
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

9.1.5. Alarm contacts

VAMP 221

Number of contacts	2 normally open contacts (relay A1&IF*) 1 normally closed contact (IF*)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s Make and carry for 3s	10 A 8 A
Breaking capacity, dc(L/R=40 ms) At 48 V dc: At 110 V dc: At 220 V dc:	 1 A 0.25 A 0.05 A
Relay material	AgNi 90/10
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm^2 (13-14 AWG)

*) Relay IF is the unit's self-supervision relay

9.1.6. Communication bus interface

Number of ports	2 in the back plate (VAMP 221) 2 in the front panel (I/O units)
Electrical connection	RJ 45
Max. number of used units	16 I/O units 3 central units
Auxiliary voltage supply to I/O units	Floating 24 V dc
Communication	RS485 (15 kV) information / self-supervision
Light/current signal	4 arc protection zones 1 overcurrent zone

9.1.7. Local serial communication port

VAMP 221

Number of ports	1 pcs in front panel
Electrical connection	RS 232
Data transfer rate	9600 kb/s (software update)

9.2. Tests and environmental conditions

Disturbance tests

Test	Standard & Test class / level	Test value
Emission	EN 61000-6-4	
- Conducted	EN 55011, class A	0.01 - 30 MHz
- Emitted	EN 55011, class A	30 - 1 000 MHz
Immunity	EN 61000-6-2 / IEC 60255-26	
- 1Mhz damped oscillatory wave	IEC 60255-22-1	±2.5kVp CM, ±1kVp DM
- Static discharge (ESD)	EN 61000-4-2 class IV / IEC 60255-22-2	8 kV contact, 15 kV air
- Fast transients (EFT)	EN 61000-4-4 class IV / IEC 60255-22-4 class A	±4 kV, 5/50 ns, 5 kHz
- Surge	EN 61000-4-5 class III / IEC 60255-22-5	2 kV, 1.2/50 μs, CM 1 kV, 1.2/50 μs, DM
- Conducted HF field	EN 61000-4-6 class III / IEC 60255-22-6	0.15 - 80 MHz, 10 Vemf
- Emitted HF field	EN 61000-4-3 class III / IEC 60255-22-3	80 - 2700 MHz, 10 V/m
- Voltage interruptions	EN 61000-4-29 / IEC 60255-11	30%/1s, 60%/0.1s, 100%/0.05s
- Voltage alternative component	EN 61000-4-17 / IEC 60255-11	12% of operating voltage (DC) / 10min
- Voltage dips and short interruptions	EN 61000-4-11	30%/10ms, 100%/10ms, 60%/100ms >95%/5000ms
- Power-frequency magnetic field	EN 61000-4-8	300A/m (continuous), 1000A/m / 1-3s
- Pulse magnetic field	EN 61000-4-9	1000A/m, 1.2/50 μs

9.2.1. Electrical safety tests

Test	Standard & Test class / level	Test value
- Impulse voltage withstand	EN 60255-5, class III	5 kV, 1.2/50 μs, 0.5 J
- Dielectric test	EN 60255-5, class III	2 kV, 50 Hz
- Insulation resistance	EN 60255-5	
- Protective bonding resistance	EN 60255-27	
- Power supply burden	IEC 60255-1	

9.2.2. Mechanical tests

Shock response	IEC 60255-21-2, Class I half sine 11 ms, Acceleration 5 g, 6 directions, 3 pulse each direction.
Shock withstand	IEC 60255-21-2, Class I half sine 11 ms, Acceleration 15 g, 6 directions, 3 pulse each direction.
Bump test	IEC 60255-21-2, Class I half sine 16 ms, Acceleration 10 g, 6 directions, 1000 pulse each direction.
Vibration -Sinusoidal response	IEC 60255-21-1, Class I Amplitude 0.035 mm Frequency 10…150 Hz Acceleration 0.5 g 3 directions, 1 sweep, sweep rate 1 oct/min
- Sinusoidal endurance	IEC 60255-21-1, Class I Frequency 10…150 Hz Acceleration 1 g 3 directions, 20 sweeps, sweep rate 1 oct/min

9.2.3. Environmental conditions

Operating temperature range	-10 … +55°C
Transport and storage temperature range - VAMP 221, VAM I/O units - ARC SLm, VA 1 xx sensors	 -40 … +70°C -40 … +85°C
Relative air humidity	<75% (1 year, average) <90% (30 days per year, condensation not allowed)

9.2.4. Casing

VAMP 221

Housing class (IEC 60529)	IP20
Dimensions (WxHxD)	208 x 155 x 236 mm 8.19 x 6.10 x 9.29 in
Material	1mm/ 0.04 in steel plate
Weight	4,2 kg
Colour code	RAL 7032 (housing) / RAL 70035 (back plate)

VAM 10L, VAM 3L, VAM 3LX, VAM 4C, VAMP 4R

Housing class (IEC 60529)	IP21
Dimensions (WxHxD)	157 x 92 x 25 mm 6.18 x 3.62 x 0.98 in
Material	1mm / 0.04 in steel plate
Weight	0.52 kg
Colour code	RAL 7032 (housing) / RAL 70035 (back plate)

VAM 10LD, VAM 12LD, VAM 4CD

Door mounted (IEC 60529)	IP64
Dimensions (WxHxD)	185 x 120 x 25 mm 7.28 x 4.72 x 0.98 in
Material	1mm / 0.04 in steel plate
Weight	0.60 kg
Colour code	RAL 7032 (housing) / RAL 70035 (back plate)

VAR 4CE

Housing class (IEC 60529)	IP21
Dimensions (WxHxD)	140 x 90 x 60 mm 5.51 x 3.54 x 2.36 in
Material	PLASTIC
Weight	0.52 kg

VA 1 DA, VA 1 EH, VA 1 DP

Housing class (IEC 60529)	IP21
Dimensions (WxHxD) - VA 1 DA - VA 1 EH - VA 1 DP	 25x55x14 mm 0.98 x 2.17 x 0.55 in ϕ11x62 mm / 0.43 x 2.44 in ϕ40x7 mm / 1.57 x 0.28 in
Material	Plastic
Weight	0.01 kg
Cable length - VA 1 DA & VA 1 EH - VA 1 DP	 6 m or 20 m / 0.23 or 0.79 in 5 m / 0.2 in

9.2.5. Package

Dimensions (WxHxD) - VAMP 221 - VAMP 4R, VAM 10, VAM 3L, VAM 3LX, VAM 4C	 215 x 160 x 275 mm / 8.46 x 6.30 x 10.83 in 157 x 92 x 25 mm / 6.18 x 3.62 x 0.98 in
Weight (unit, box and user instructions) - VAMP 221 - VAMP 4R, VAM 10, VAM 3L, VAM 3LX, VAM 4C	 5.2 kg 0.62 kg

9.3. Protection stages

NOTE! See Chapter 2.1 for description.

9.3.1. Arc (fault) protection

L1/L3 setting stage

Start current	0.5…6*I_N
Operating time	7 ms
Detection period Resetting period	2 ms 30 ms

L2/I_0 setting stage

Start current	0.05…5* I_N
Operating time	7 ms
Detection period Resetting period	2 ms 30 ms

9.3.2. Circuit breaker failure protection stage (50BF)

Monitored relay	One relay in the tripping group (Trip 2 or Trip 4)
Operating time	100 ms or 150 ms

9.4. Unbalance alarm

Detecting limit	90%
Operating time	10 s

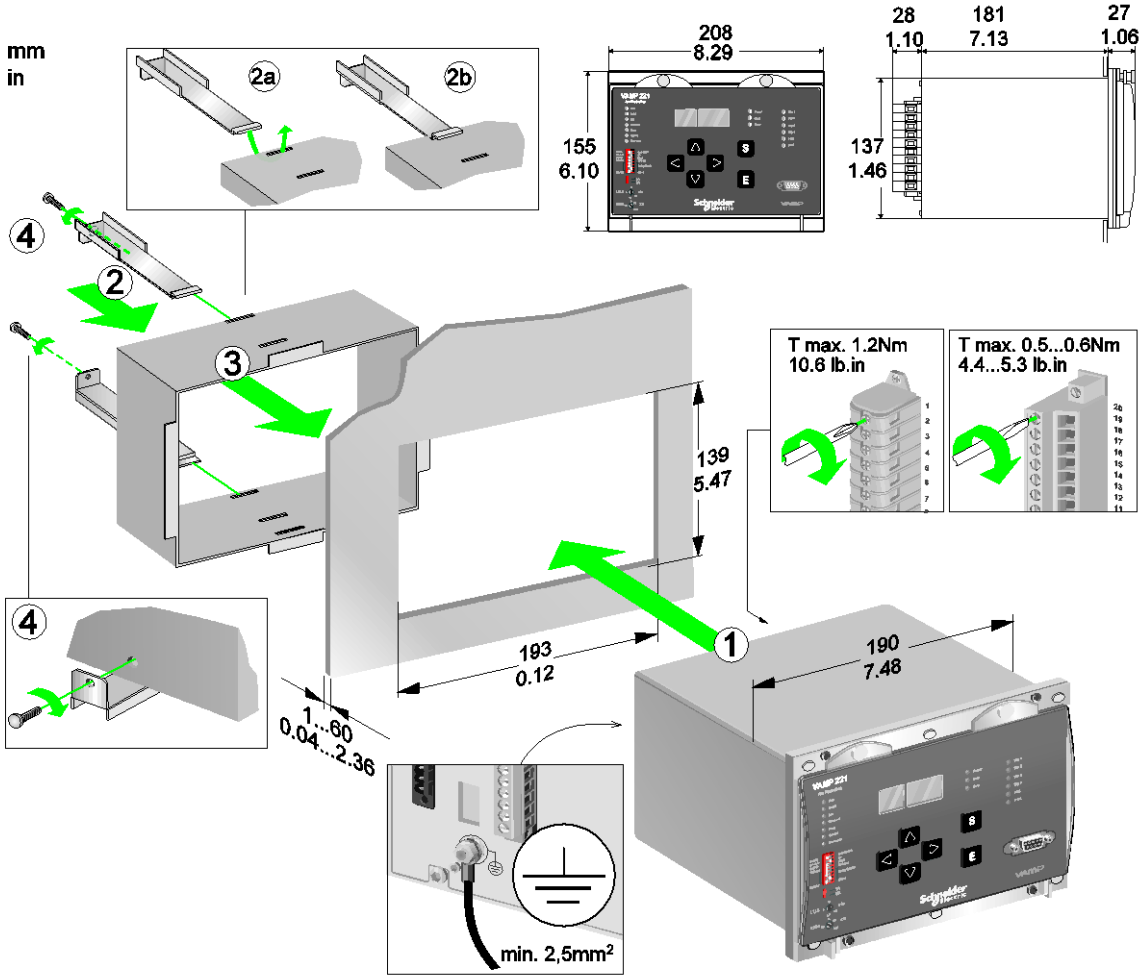
NOTE! Unbalance error has been removed from the software version 3.12 onwards.

10. Construction

10.1. Dimensional drawings

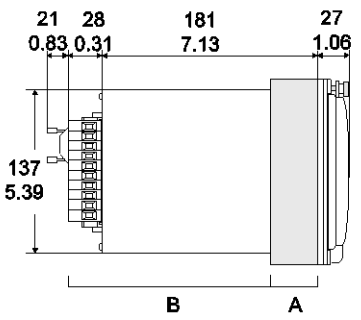
10.1.1. VAMP 221

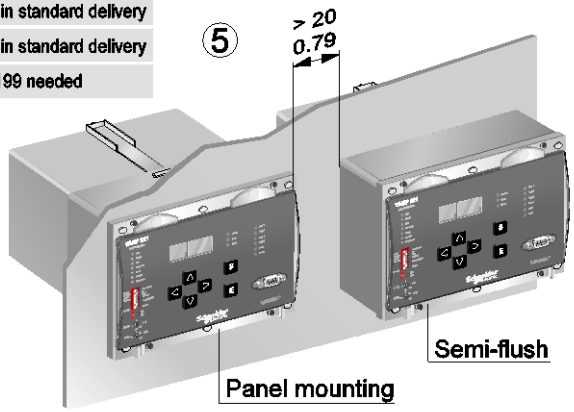
PANEL MOUNTING VAMP 221 SYSTEM



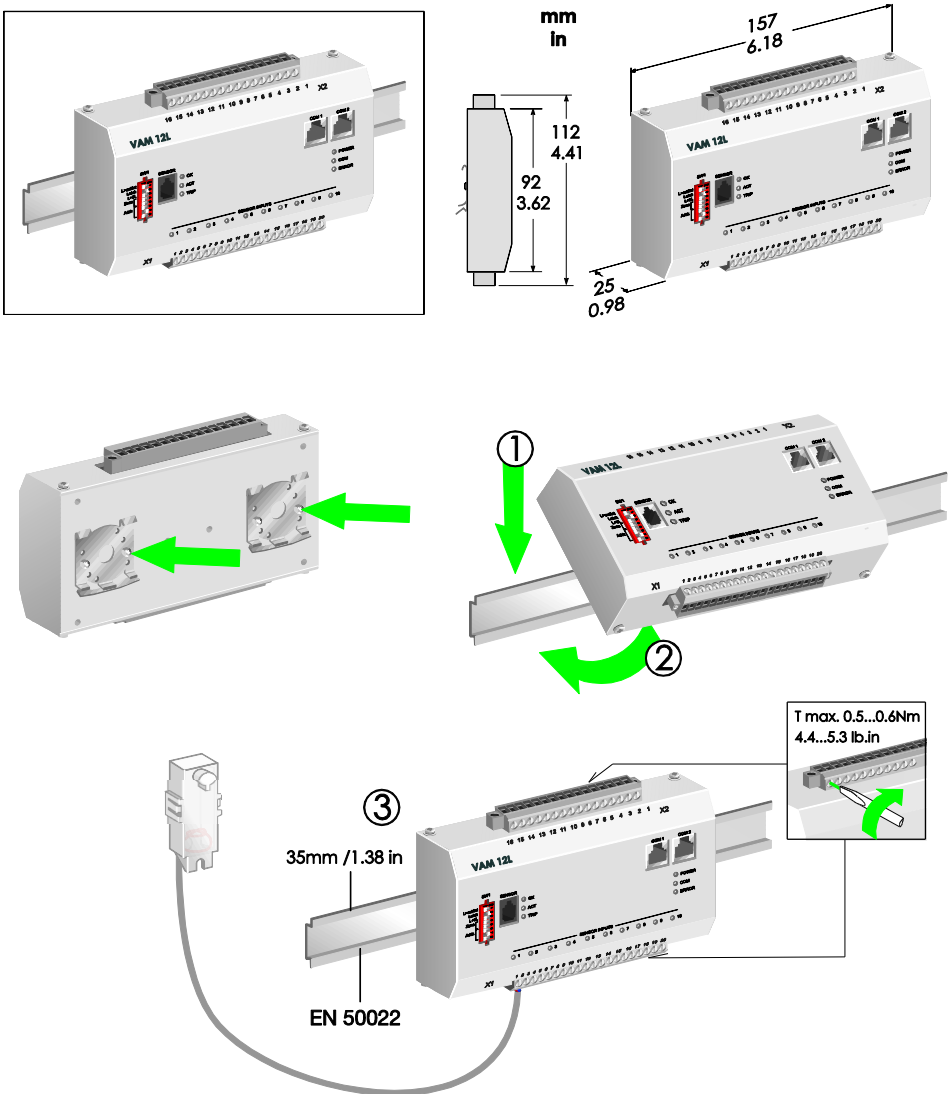
SEMI-FLUSH VAMP 221 SYSTEM

Raising frame	A	B	Fixing bracket
VYX076	40 mm /1.57!	169 mm/ 6.65!	Included in standard delivery
VYX077	60 mm /2.36!	149 mm/ 5.87!	Included in standard delivery
VYX233	100 mm / 3.94!	109 mm/4.29!	2 x VYX199 needed

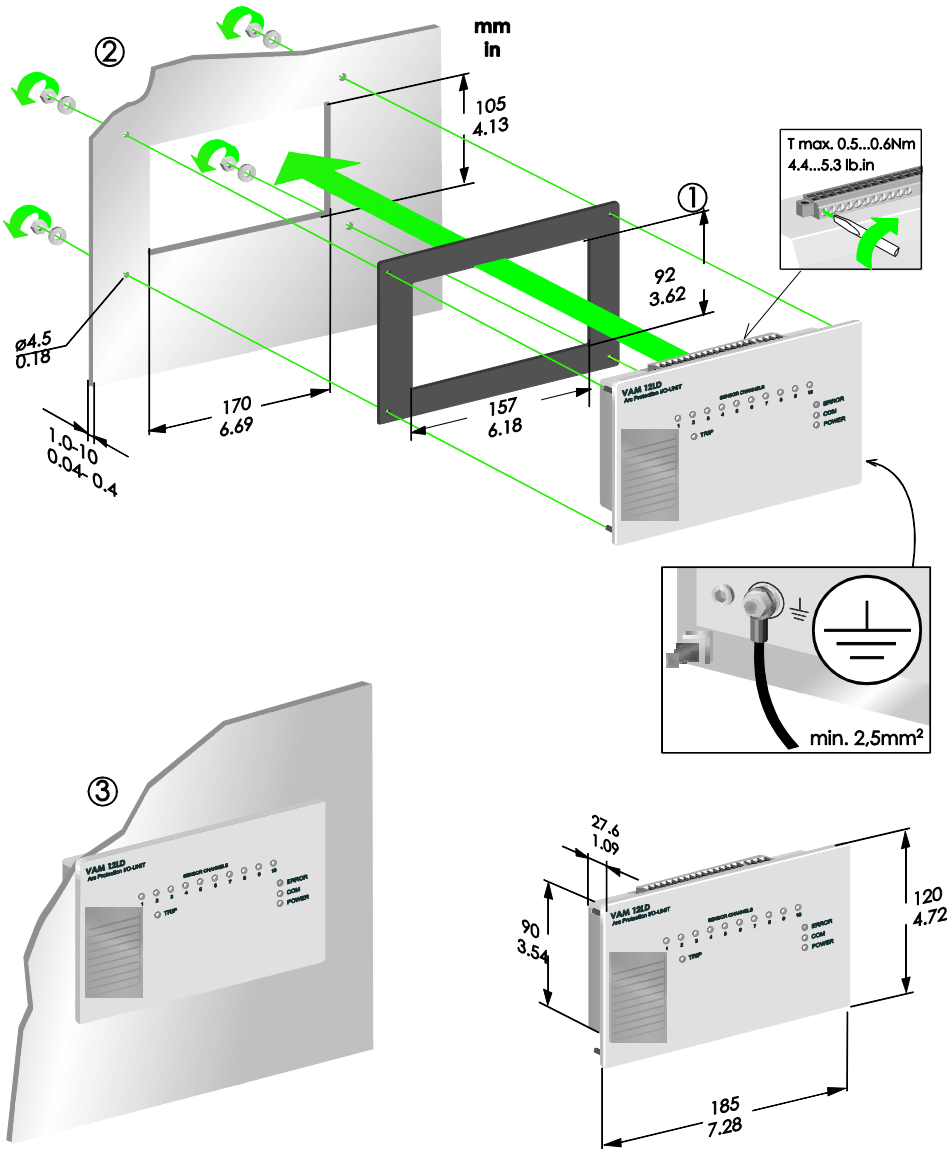




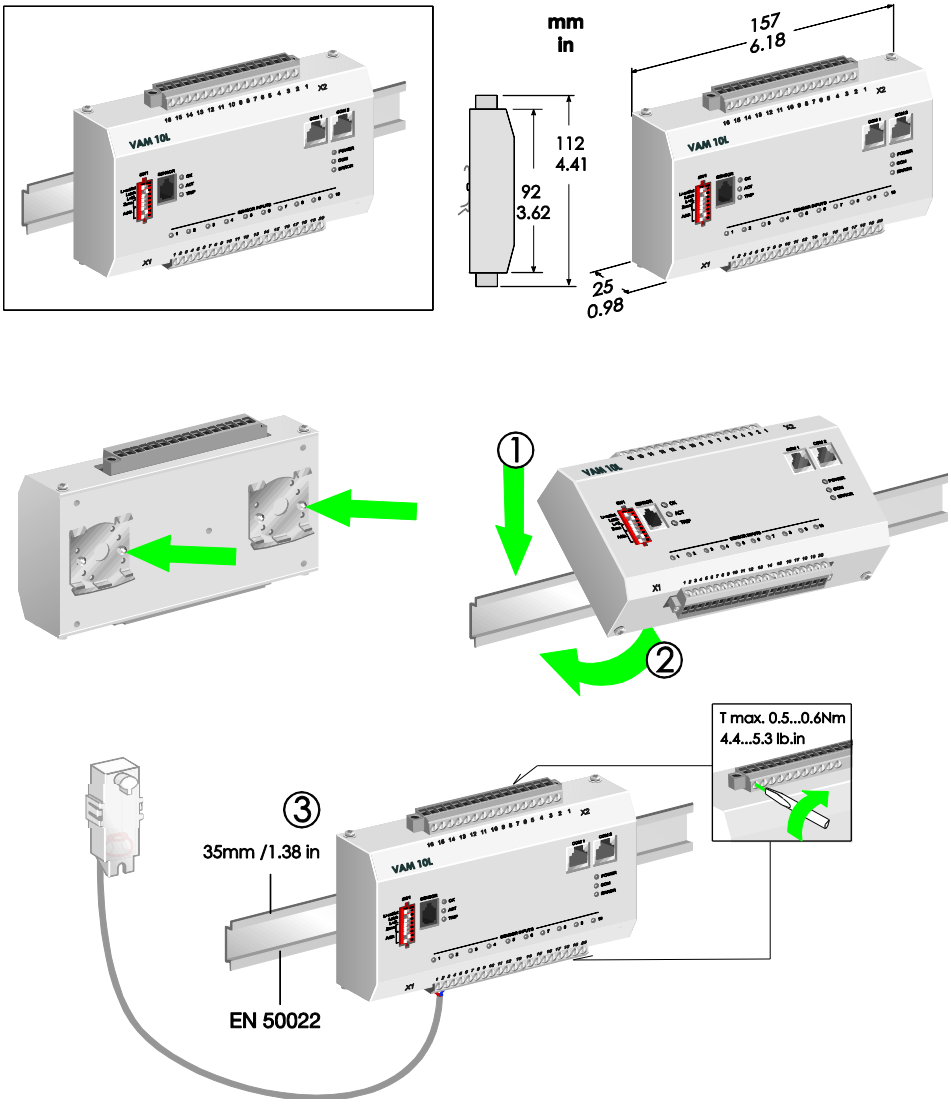
10.1.2. VAM 12L


mm
In
157
6.18
112
4.41
92
3.62
25
0.98
VAM 12L
①
②
③
T max. 0.5...0.6Nm
4.4...5.3 lb.in
35mm /1.38 in
EN 50022

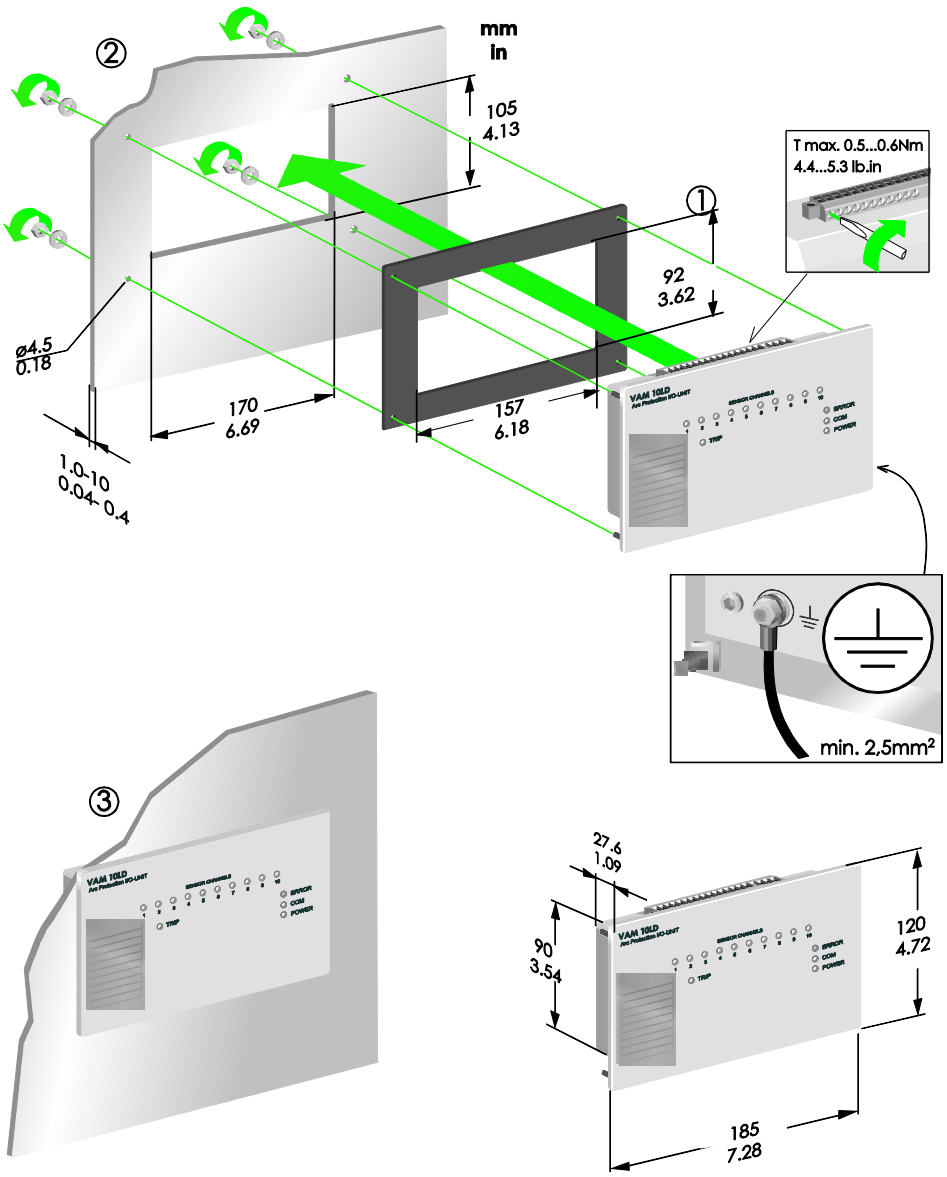
10.1.3. VAM 12LD



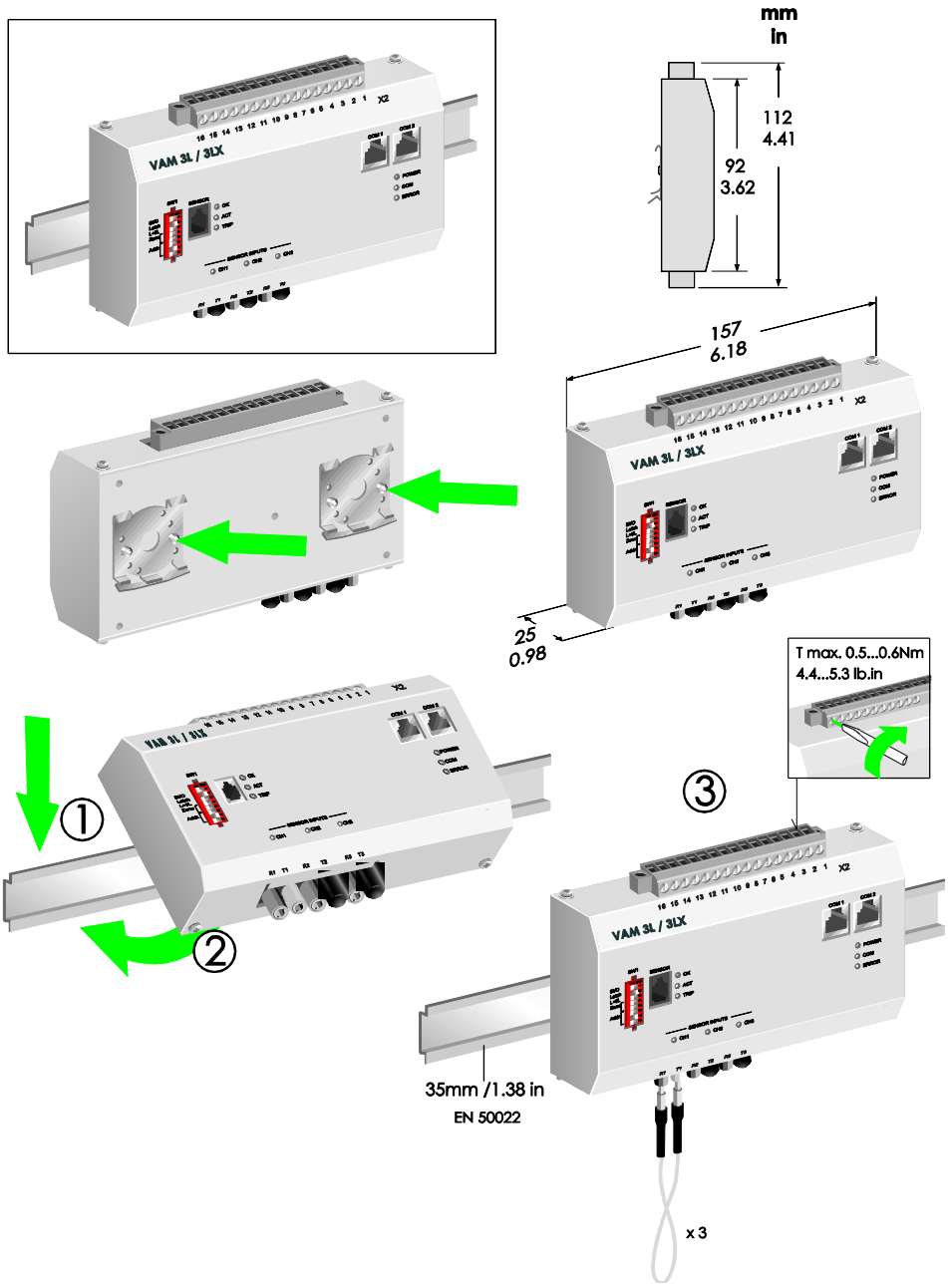
10.1.4. VAM 10L


mm
in
157
6.18
112
4.41
92
3.62
25
0.98
VAM 10L
①
②
③
T max. 0.5...0.6Nm
4.4...5.3 lb.in
35mm /1.38 in
EN 50022

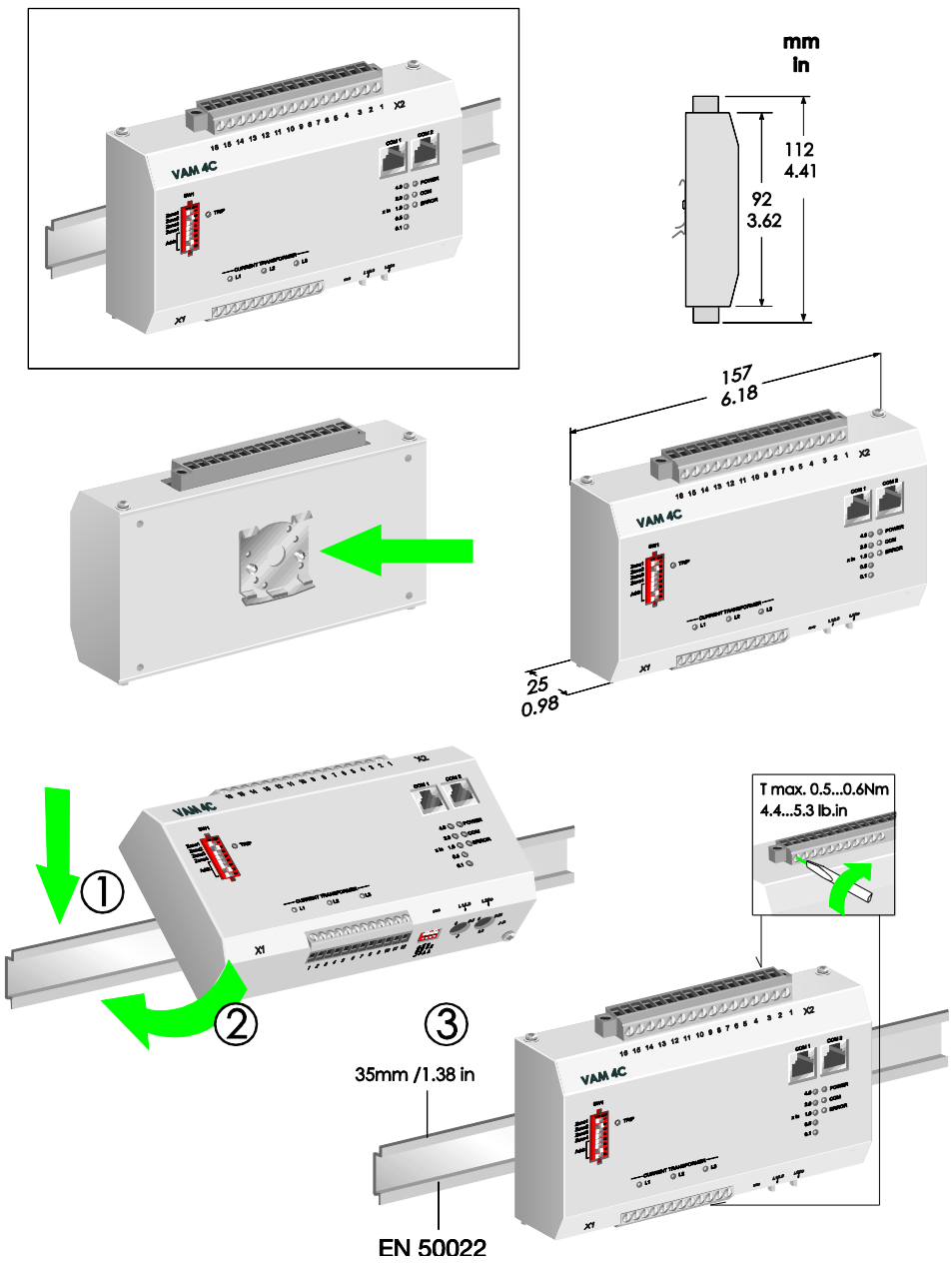
10.1.5. VAM 10LD



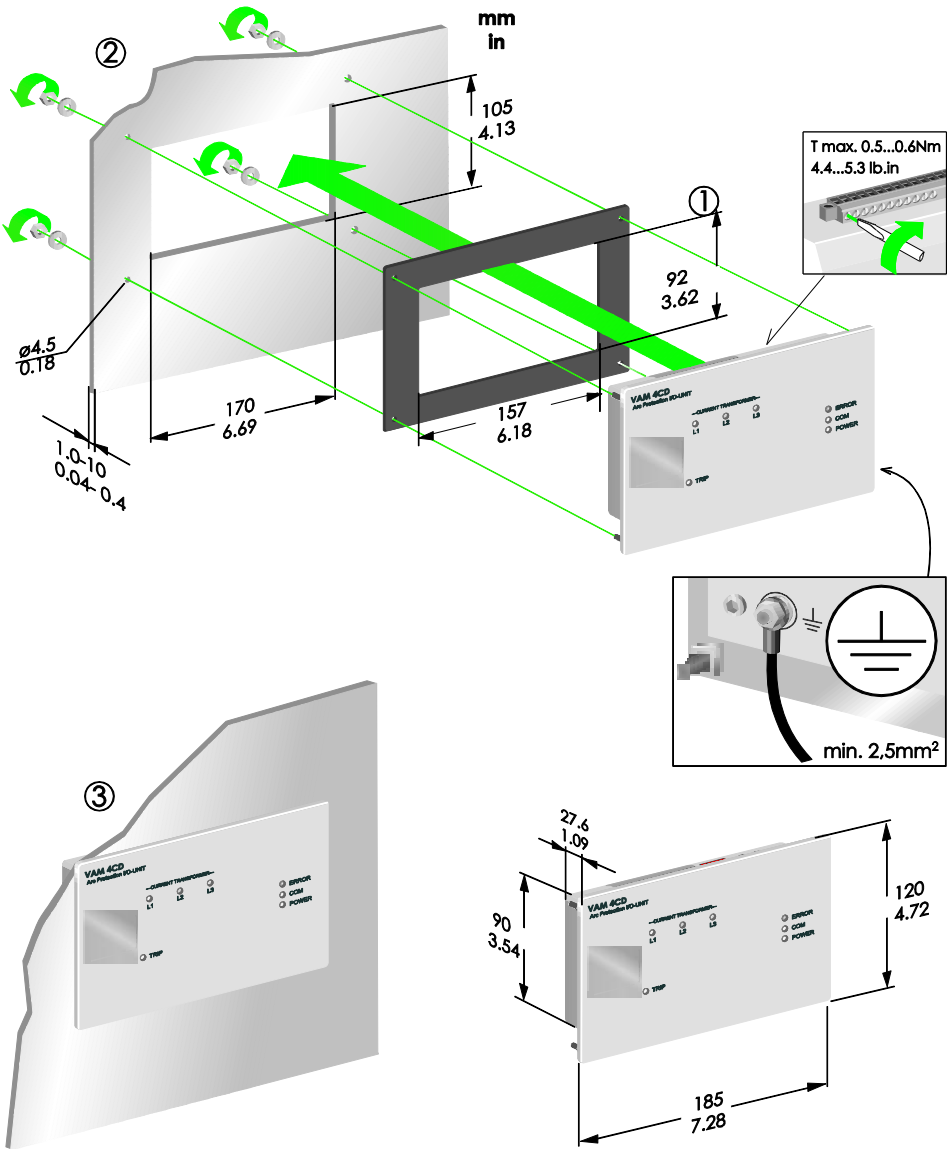
10.1.6. VAM 3L / 3LX



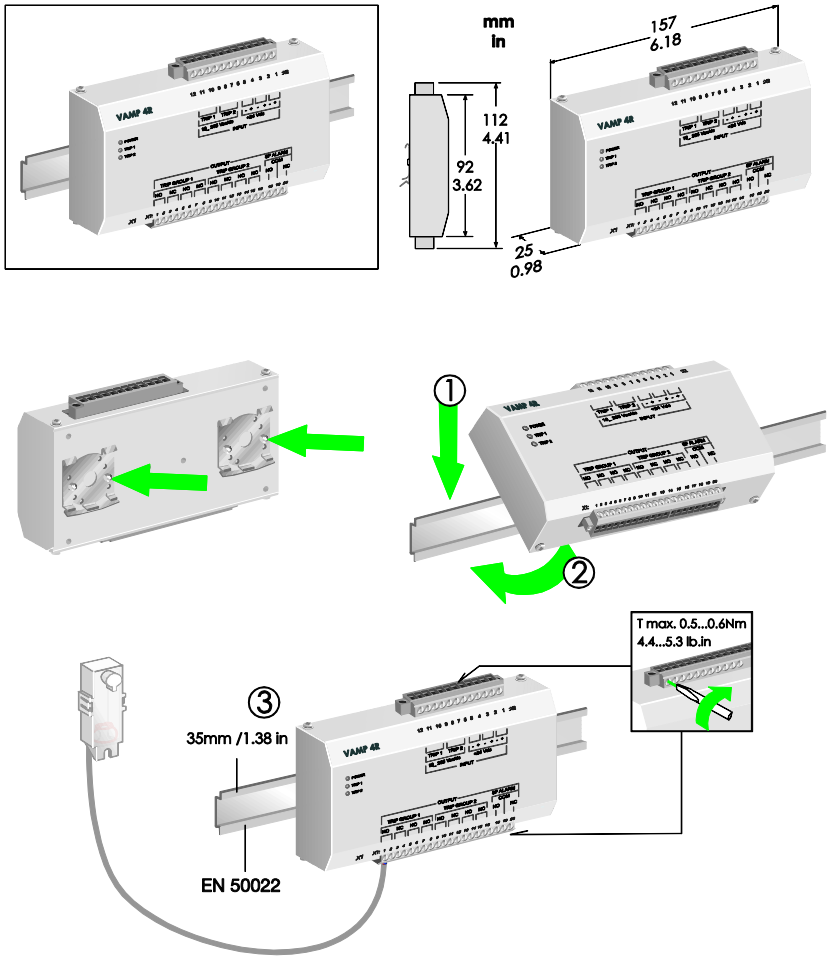
10.1.7. VAM 4C


mm
in
112
4.41
92
3.62
157
6.18
25
0.98
VAM 4C
T max. 0.5...0.6Nm
4.4...5.3 lb.in
35mm /1.38 in
EN 50022

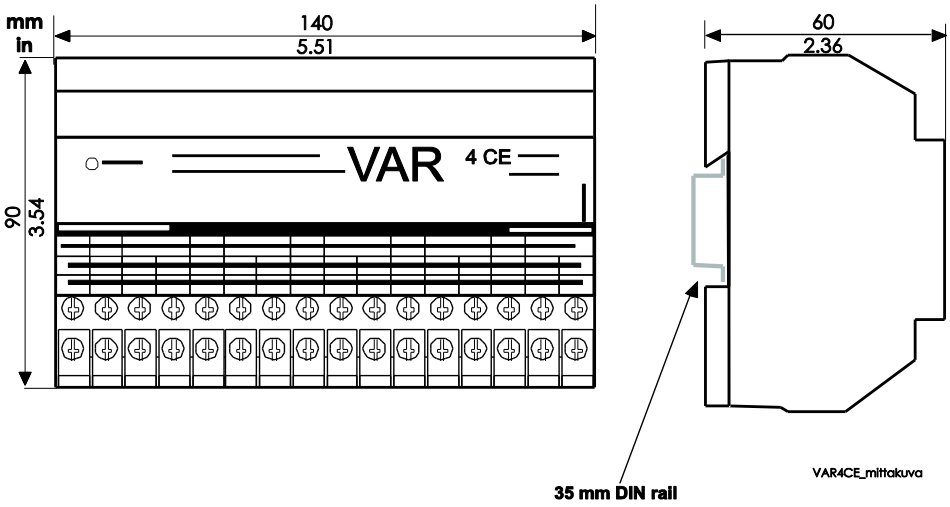
10.1.8. VAM 4CD


mm
in
②
105
4.13
①
92
3.62
T max. 0.5...0.6Nm
4.4...5.3 lb.in
ø4.5
0.18
170
6.69
157
6.18
1.0-10
0.04-0.4
min. 2,5mm²
③
27.6
1.09
120
4.72
90
3.54
185
7.28

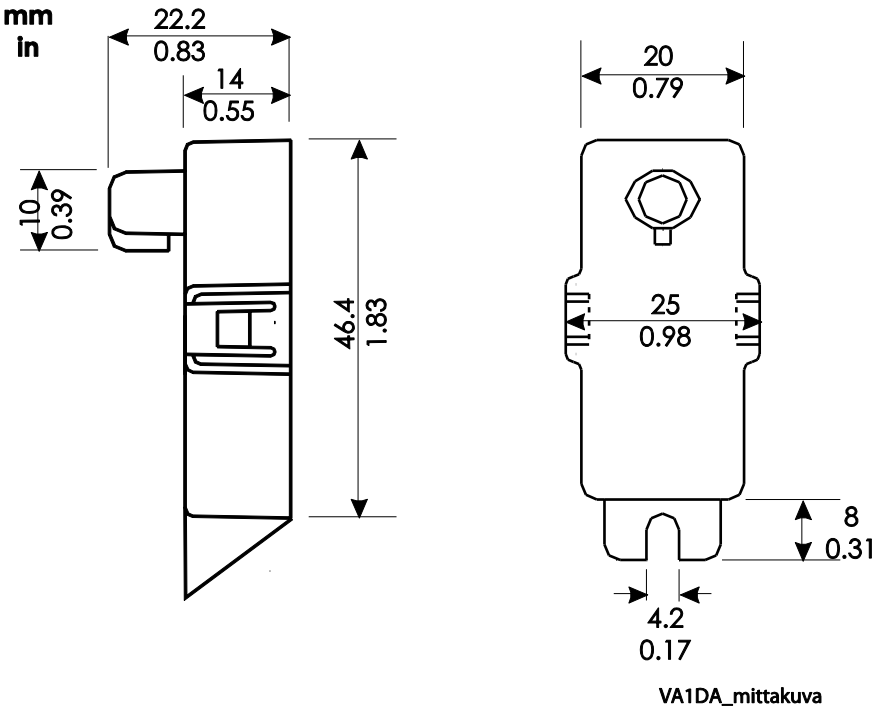
10.1.9. VAMP 4R


mm
in
157
6.18
112
4.41
92
3.62
25
0.98
①
②
③
T max. 0.5...0.6Nm
4.4...5.3 lb.in
35mm /1.38 in
EN 50022

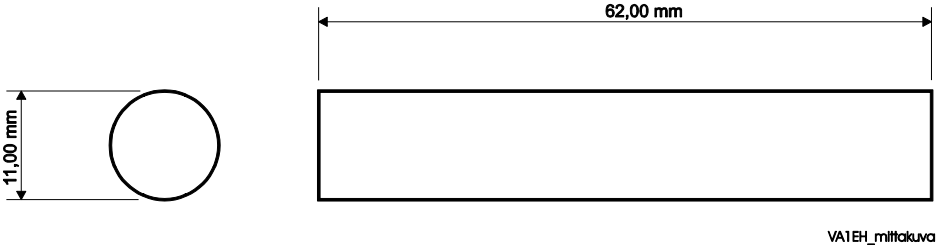
10.1.10. VAR 4CE



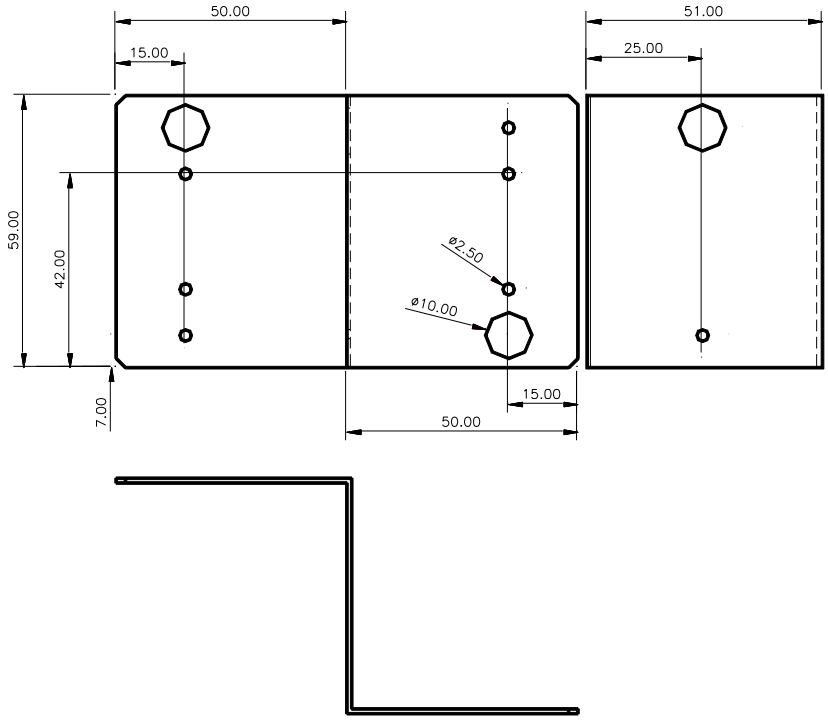
10.1.11. VA 1 DA



10.1.12. VA 1 EH

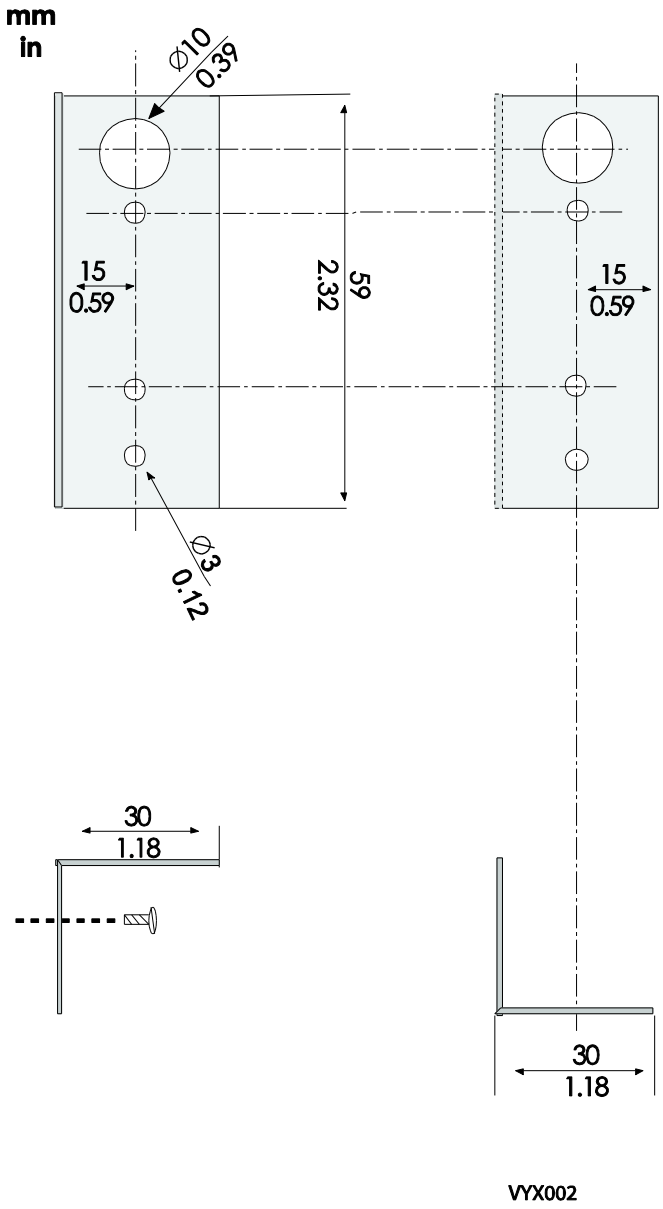


10.1.13. VYX 001

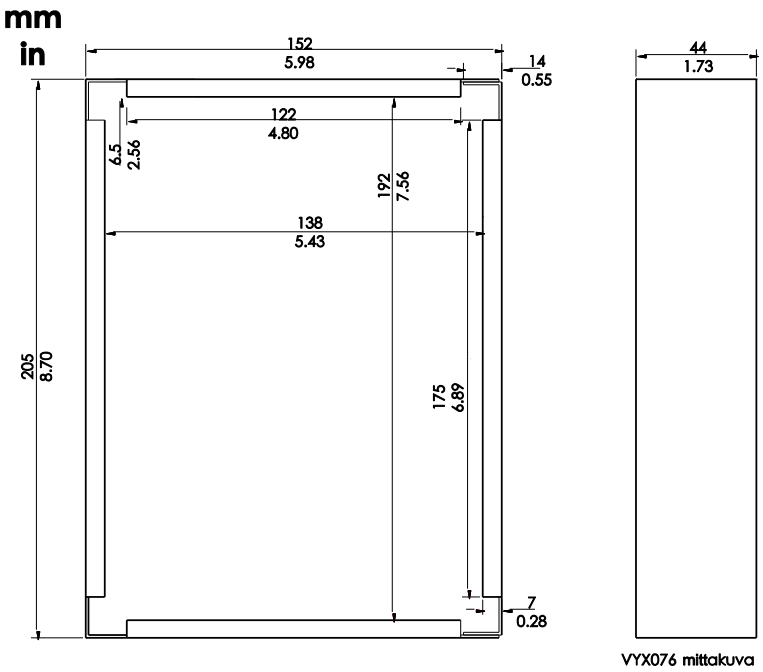


VYX001_mittakuva

10.1.14. VYX 002

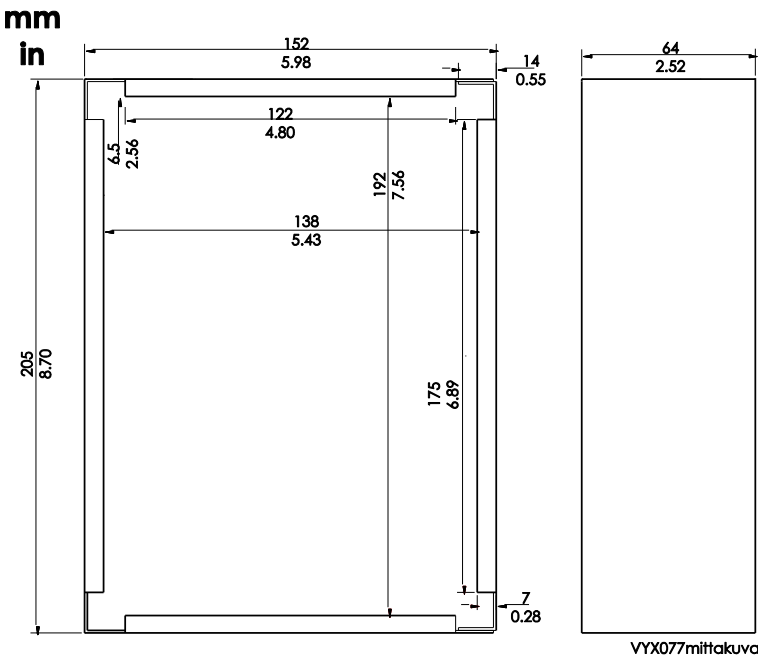


10.1.15. VYX 076



VYX076 mittakuva

10.1.16. VYX 077



VYX077mittakuva

10.2. Unit installation

Caution!

Read this User's Manual carefully before undertaking any installation or wiring work.

Safety instructions

Always observe the national electrical safety regulations when working under live conditions. The unit manufacturer is not liable for damage due to incorrect working methods or failure to observe safety instructions.

The correct handling of the unit under all mounting and operating conditions forms the foundation for its safe use.

Caution!

Any separately marked notes and warnings must be observed.

The wiring work must be performed according to national standards and any requirements specified by the customer.

Caution!

Do not connect the auxiliary supply voltage until the installation has been completed.

Before installation

Before installation, make sure the environmental conditions comply with the requirements specified in Chapter 5.

Caution!

The unit contains components liable to damage if exposed to an electrostatic discharge (ESD). Do not open the unit unless you have taken appropriate protective measures against ESD.

Caution!

The manufacturer cannot guarantee operational safety in environments that do not satisfy the specified environmental conditions.

10.2.1. VAMP 221

The central unit is designed for flush mounting. Spacing adapters for reducing the installation depth are available on request.

Wiring of the central unit, overview

The central unit can be connected to the following:

- secondary circuits of the current transformers of the switchgear
- the trip circuits of the circuit breakers
- alarm circuits
- auxiliary supply circuits
- protective earthing
- connections to I/O units (data communication and auxiliary supply)
- connections to other central units or protection relays

NOTE! In VAMP 221 the auxiliary supply is connected to terminals X3:17 and X3:18.

Wiring secondary circuits of the current transformers

Connect the secondary circuits of the current transformers to the following screw connectors in the back plate:

X1-1, X1-2 (L1)

X1-3, X1-4 (L2/Io)

X1-5, X1-6 (L3)

The arc protection system can also be single or two-phase connected. Three-phase connection is nevertheless recommended for optimal operating speed.

NOTE! The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. If only two phases are connected, they should be connected to L1 and L3. Single-phase current or earth-fault current must always be connected to the current measuring channel L2/I_0; as of software version 3.12 unbalance error has been removed.

NOTE! The specified operating time of 7ms can only be guaranteed for three-phase current measurement.

Wiring the trip circuits of the circuit breakers

Connect the circuit breaker's trip circuits to the following terminals (a maximum of four separate trip outputs in two separate groups):

TRIP1:	X1-7, X1-8	(fast, group 1)
TRIP2:	X1-9, X1-10	(fast/CBFP, group 1)
TRIP3:	X1-11, X1-12	(fast, group 2)
TRIP4:	X1-13, X1-14	(fast/CBFP, group 2)

In the event of an arc fault, the output contact will close at 7 ms when three-phase current measurement is used.

If CBFP is used, the trip relays 2 and 4 will operate after a pre-set delay time of 100 or 150 ms if the preconditions for the arc fault still exist.

If several trips are required, the multiplying relay VAR 4CE can be used.

Wiring alarm circuits

Alarm signals generated by the arc protection system (trip and self-supervision alarms) can be forwarded to higher-level switchgear supervision and control systems through the output contacts.

Self-supervision alarms

The self-supervision system issues a self-supervision alarm when it detects a fault in a central unit function or an incorrect number of sensors.

Connect the self-supervision alarm output to an IF change-over contact, either terminals X1-17, X1-18 (normally closed) or X1-18, X1-19 (normally open).

During normal system operation (no internal fault) and with the auxiliary power supply connected, the terminal X1-17 or X1-18 is open and X1-18 or X1-19 is closed.

Trip alarms

A trip alarm is generated when the arc fault system trips.

Connect the trip alarm output to the closing terminals X1-15, X1-16.

Connecting protective earthing

Connect the arc protection system to the earth using the PE terminal in the back plate.

Wiring the auxiliary supply

Connect the auxiliary supply voltage to the Us input, terminals X3-17 X3-18.

NOTE! If possible, the auxiliary supply should be taken from a power source that is not interrupted during arc protection system operation.

CAUTION! Keep the auxiliary supply disconnected during mounting.

10.2.2. I/O units

VAM 12L, VAM 10L, VAM 3L, VAM 3LX, VAM 4C

The units are designed for mounting on a DIN rail. Mount the units on the rail in such a way that the indicator lights on the front panel are visible and the sensor wiring can be made as easily as possible.

VAM 12LD, VAM 10LD, VAM 4CD

The units are designed for mounting on a door. Hence all indicators are clearly visible in normal operation.

Wiring I/O units

The I/O units can be connected to the following:

- secondary circuits of the current transformers of the switchgear (VAM 4C only)
- the trip circuits of the circuit breakers
- external auxiliary supply circuits
- connections to the central unit or other I/O units (data communication and auxiliary supply)
- connections to other central units or protection relays (DI or DO bus)

Wiring the secondary circuits of the current transformers (VAM 4C / VAM 4CD only)

Connect the secondary circuits of the current transformers to the following screw connectors:

- X1-1, X1-3 (L1)
- X1-5, X1-7 (L2/I0)
- X1-9, X1-11 (L3)

The arc protection system can also be single or two-phase connected. Three-phase connection is nevertheless recommended for optimal operating speed.

NOTE! The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. Single-phase current or earth-fault current must always be connected to the current measuring channel L2/I_0; otherwise, an unbalance error will occur.

NOTE! The specified operating time of 7ms can only be guaranteed for three-phase current measurement.

Wiring the trip circuits of the circuit breakers

Connect the circuit breaker's trip circuit to the following terminals:

TRIP1: X2-15, X2-16 (fast)

In the event of an arc fault, the output contact will close at 7 ms when three-phase current measurement is used.

The output trip relay of the light I/O units (VAM 10L and

VAM 3 L) operates during faults in its own zone. In the current I/O unit (VAM 4 C), select the protection zone controlling the I/O unit using the programming switches.

If several trips are required, the multiplying relay VAR 4CE can be used.

Wiring between the central unit and the I/O unit

Connect the central unit to the I/O units with a modular cable of type VX001. The modular cable carries all information between the central unit and I/O units, including data in serial form, arc fault messages and operating supply to the I/O units.

- Connect the VX001 cable to the X6 cable outlet (COM2) or the interface X3-1...6 of the central unit (COM1). Both COM ports can be used simultaneously.

CAUTION!

If you use the terminal X3-1...6, pay particular attention to the wiring of the signals. Faulty wiring may damage the communication between the central unit and the I/O units.

- Connect the cable to COM1or COM2 on the first I/O unit.
- Route the cable from COM1 or COM2 on the first I/O unit to COM1 or COM2 in the next unit, etc.

All the COM1 and COM2 interfaces are identical, i.e. the cable can always be connected to either interface. The maximum total length of the modular cable, taking into account all the I/O units connected to the central unit, is 100 m.

Wiring separate auxiliary supplies

When routing modular cables over long distances or when the system contains more than five I/O units, you should preferably use a separate auxiliary supply parallel with the modular cable.

Connect the auxiliary supply to the 24 V terminals X3-1 and X3-2 in the central unit to the 24 V terminals X2-1 and X2-2 in the I/O units. Alternatively, you can also use a separate external direct voltage supply.

NOTE! Pay particular attention to the polarity of the cable connections.

10.2.3. Arc sensors

Mount the sensors on the switchgear in such a way that they cover the protection zone as completely as possible. The line of sight must be free between the sensor and the supervised area.

If point sensors are used in open compartments (such as bus-bar sections), there should be a sensor approximately every 5 meters. Due to the wide detection range of the sensors and the light reflection inside the switchgear, the mounting position is not critical.

Connecting sensors VA 1 DA and VA 1 EH to the I/O units

The sensors are delivered with 6-metre standard cables or 20-metre shielded cables (to be specified in the order).

After mounting the sensors, connect them to the I/O units as follows:

- Draw the wire to the nearest I/O unit using the shortest route possible and cut it to a suitable length.
- Connect the arc sensors to the screw terminals X1-1…20. The polarity of the arc sensor cables is not critical.

Connecting the ARC-SLx sensors to the I/O units

The sensors are delivered in standard lengths (to be specified in the order) equipped with terminals compatible with VAM 3L units.

After mounting the sensors, connect them to the I/O units as follows:

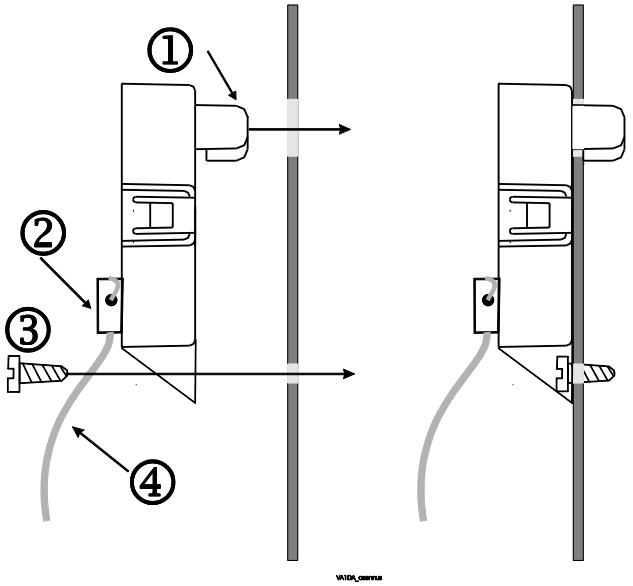
- Draw each end of the sensor to the I/O unit and carefully form a loop of the extra fibre.

NOTE! Do not shorten the extra sensor fibre unless you have appropriate terminal connectors.

- Connect the arc sensors to plug-in terminals X1-R1, T1…R3, T3. While the polarity of the arc sensors is not critical, you must connect each end of the fibre to the same channels.

VA 1 DA

You can be install the arc sensor onto the switchgear wall from the outside. Press the active part of the sensor through the 10-mm hole in the wall and fix it using a 4-mm screw.



①Active part of the sensor ②Cable clamp ③ Fastening screw 4x15 mm
④Cable of sensor

Figure 10.2.3-1 Mounting the arc sensor VA 1 DA

You can also surface mount the sensor to the wall using the mounting plates VYX01 or VYX02, available as additional parts.

NOTE! The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

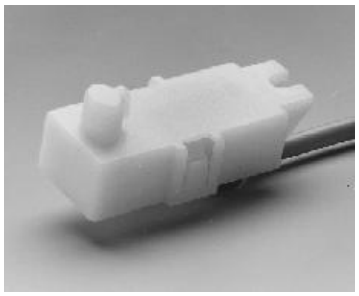


Figure 10.2.3-2 Arc sensor VA 1 DA

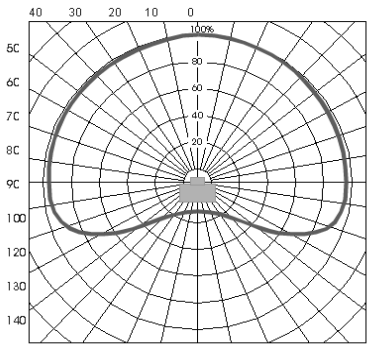


Figure 10.2.3-3 Sensitivity of the arc sensor VA 1 DA

VA 1 EH

You can be install the arc sensor onto the switchgear wall from the outside. Press the active part of the sensor through the 10.5-mm hole in the wall.

You can also surface mount the sensor. To do this, push the sensor into a plastic mounting tube and fix it with heat shrink tubing.

NOTE! The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

Figure 10.2.3-4 Arc sensor VA 1 EH

ARC-SLx

ARC-SLx is an fibre sensor that can be mounted on the switchgear to monitor several compartments simultaneously (various bus-bar compartmets, etc.).

The fibre must not touch any live parts of the switchgear or other hot components, since too high temperatures may destroy the fibre.

When mounting the sensor on the switchgear, ensure that the bending radius is long enough (min. 80 mm) and that it is safe from the sharp edges of the switchgear.

NOTE! The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

NOTE! To avoid false tripping, cover any unused channels of the I/O unit.

VA 1 DP

The portable pin sensor can be temporarily connected to the I/O units. It is used to improve safety when working with live switchgear, for example, Attach the sensor close to the working area, for example in the breast pocket of the maintenance man.

A pin sensor operates in the same way as a fixed arc sensor. The only difference is free mobility within the limits of the connecting cable.

Figure 10.2.3-5 Pin sensor VA 1 DP

NOTE! To avoid faulty tripping, disconnect the pin sensor from the system immediately after use.

10.2.4. VAR 4 CE

The multiplying relay VAR 4CE can be used when more than 4 trip outputs are needed simultaneously.

Attach the multiplying relay to the DIN rail near where the central unit is mounted.

Connect the auxiliary voltage to terminals X3-1 (+) and X3-2 (GND) of the central unit or to terminals X2:1 (+) and X2:2 (GND) in the I/O unit and to terminals 1 (+) and 3 (GND) or 2 (+) and 4 (GND) in the multiplying relay. Note the polarity of the wires.

Connect the required trip output to terminals 5,7 or 6,8 in the multiplying relay.

Connect the necessary trip controls to terminals TRIP1 - TRIP4 of the multiplying relay.

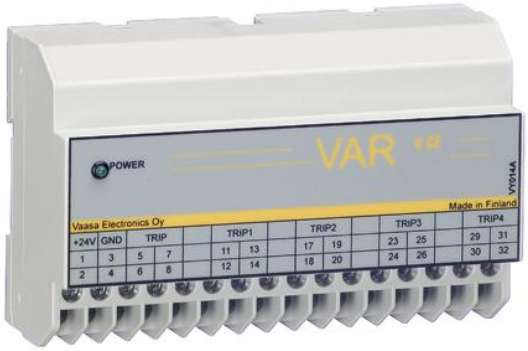


Figure 10.2.4-1 Multiplying relay

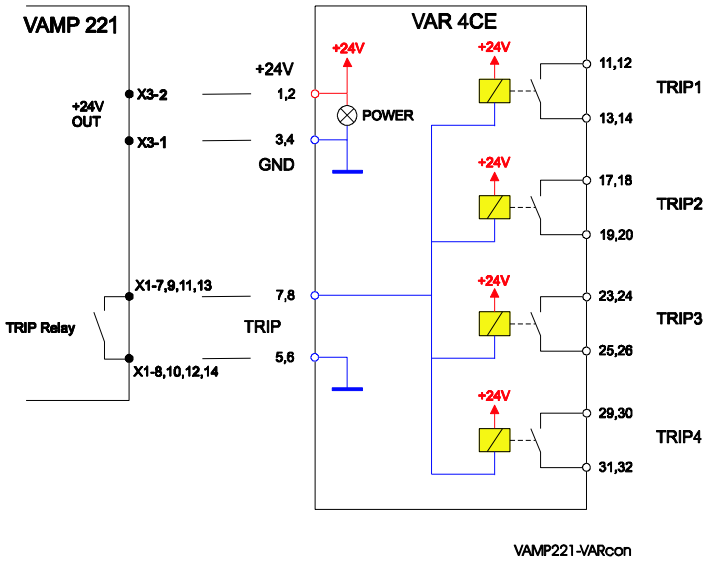


Figure 10.2.4-2 Multiplying relay inteface

10.2.5. VAMP 4R

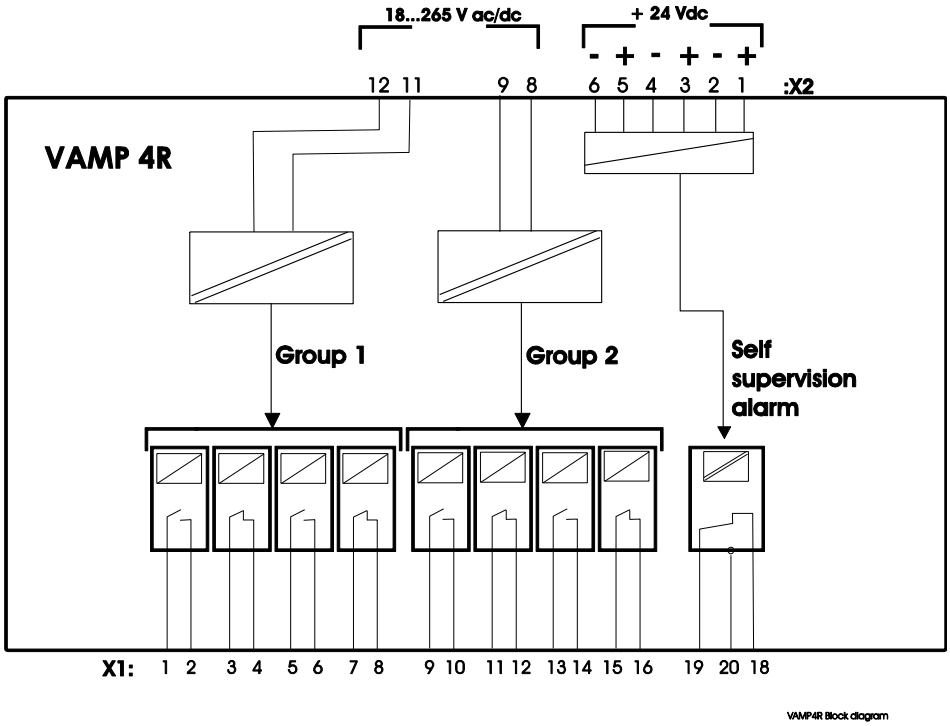

18...265 V ac/dc
+ 24 Vdc
- + - + - +
12 11 9 8 6 5 4 3 2 1 :X2
VAMP 4R
Group 1
Group 2
Self supervision alarm
X1: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 19 20 18
VAMP4R Block diagram

Figure 10.2.5-1 VAMP 4R block diagram

The multiplying relay VAMP 4R can be used when additional trip outputs are needed.

VAMP 4R comprises 4 N/O contacts and 4 N/C contacts. They are divided into two separate groups which can be independently controlled by e.g. the binary output of the I/O units or the central unit (VAMP 221).

- Attach the VAMP 4R unit to a DIN rail.
- Connect the auxiliary voltage (+24V) to terminal X2-1 (+) and X2-2 (-). Terminals X2-3 and X2-5 are parallel inputs to X2-1(+). Terminals X2-4 and X2-6 are parallel inputs to X2-2(1). The auxiliary voltage (+24V) can be supplied from the central unit or nearest slave (X2-1 (+), X2-2 (-)).
- Connect the required signal (18-265 V ad/dc) to the trip control inputs.
- Input “TRIP 1” (X2-11, X2-12) is controlling the trip group 1.

  Input “TRIP 2” (X2-8, X2-9) is controlling the trip group 2.
- There are 2xN/C + 2xN/O contacts per trip group.

If necessary, input TRIP 1 and 2 can be connected in parallel. Then all trip relays will operate simultaneously.

10.2.6. Wiring multiple central units

A maximum of three central units can be connected to one communication bus. In this case, the units can operate on a maximum of four protection zones (depending on their programming switches). The light and current signals given by the I/O units, including address information, are transferred to each central unit.

If more than one central unit is to be connected to the same communication bus, one central unit must be in central unit mode and the other central units in sub-unit mode (programming switch SW1:8).

In applications with multiple central units the central units can be interconnected also via BI/O connections (binary input/output). In this case, each part of the system can control four protection zones per system communication bus. In this case, arc and overcurrent information is transferred between the central units without address information.

NOTE! When configurating arc protection system with multiple central units, disconnect I/O-units from central units in slave mode during their installation procedure.

The following BI/O connections are included in the standard delivery:

La>in	X3-8	Arc input, tripping group 1
Lb>in	X3-9	Arc input, tripping group 1
Ib> in/out	X3-10	Overcurrent input/output
La> out	X3-11	Arc output, tripping group 1
Lb> out	X3-12	Arc output, tripping group 2
GND	X3-13, X3-14	Grounding for all BI/O signals

To obtain transfer of arc information between central units:

- Connect the systems using the BI/O terminals X3-8, 9, 11 or 12 (+).
- Connect the terminals X3-13 or 14 (GND).

To obtain transfer of overcurrent information between central units:

- Connect the systems using the BI/O terminals X3-10 (+).
- Connect the terminals X3-13 or 14 (GND).

NOTE! Note the polarity of the cables.

Figure 10.2.6-1 shows an example connection where arc information is transferred in both directions between central units. See Chapter 3.3 for an application example.

The system's I/O units should be connected to the central units in the same zone.

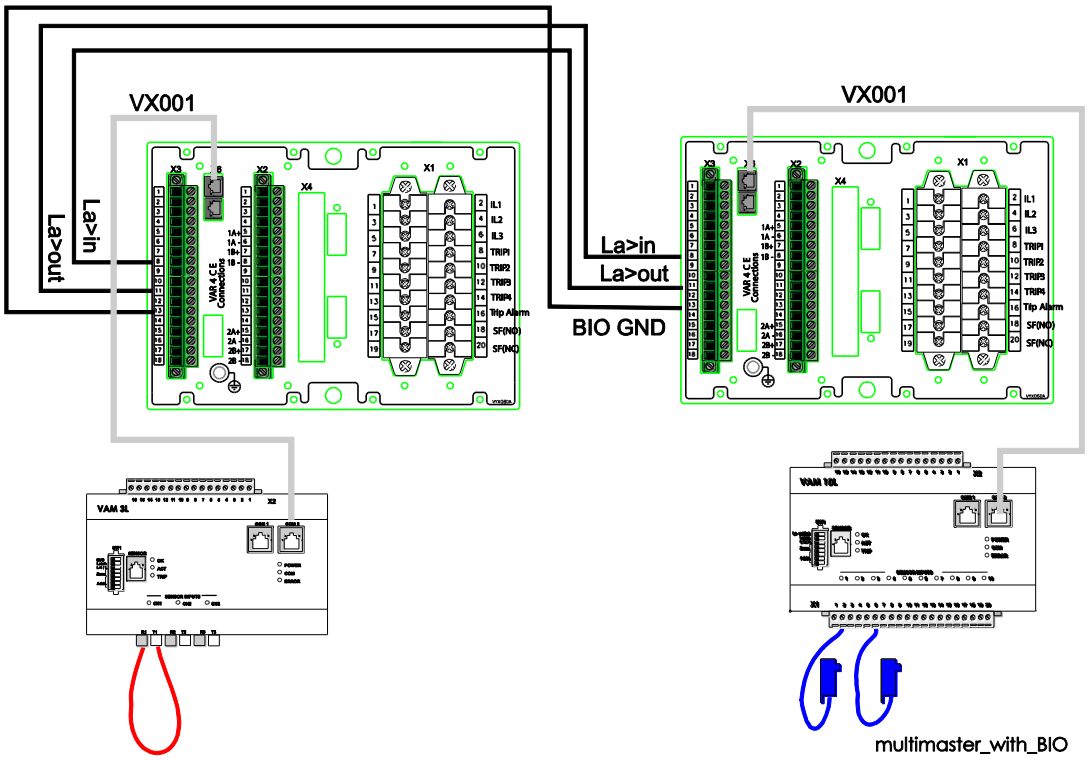


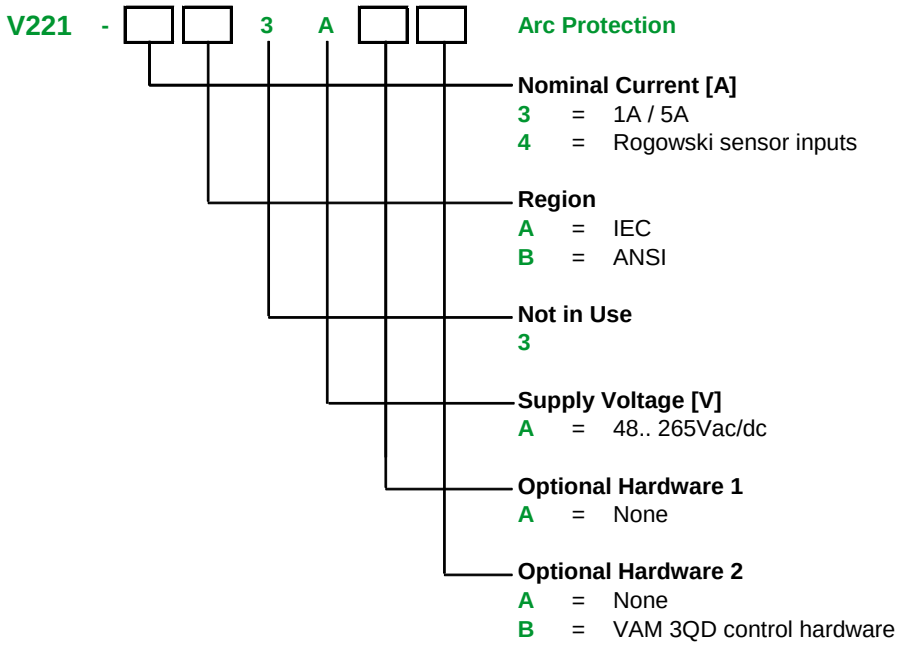
Figure 10.2.6-1 Arc protection system with two central units (example)

11. Order information

When ordering, please state:

- Type designation: V 221
- Quantity:
- Options (see respective ordering code):

Vamp 221 ordering code



Accessories :

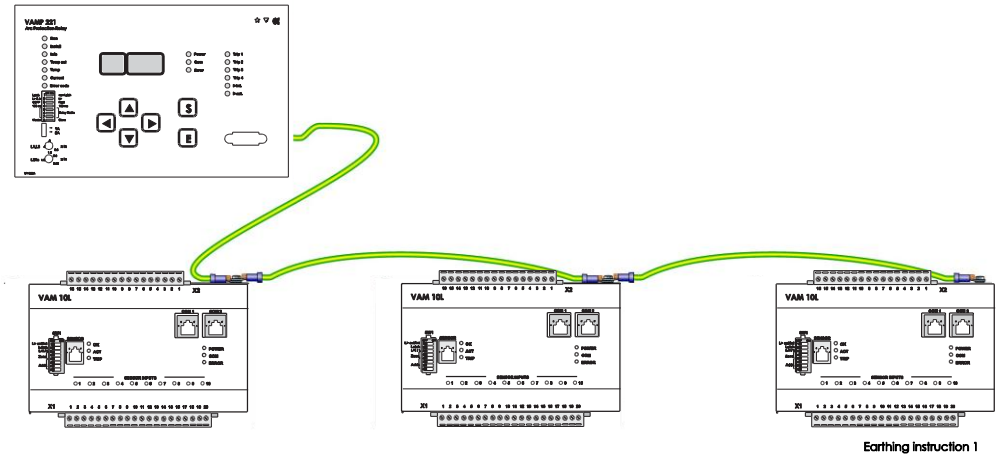
Order Code	Explanation	Note
VAM 3L	Fiber sensor I/O unit (VAMP221 & 321)	3 fiber loops, 1 trip relay
VAM 3LX	Fiber sensor I/O unit (VAMP221 & 321)	3 fiber loops, 1 trip relay, adjustable sensitivity
VAM 4C	Current I/O unit (VAMP221 & 321)	3 current inputs, 1 trip relay
VAM 4CD	Current I/O unit (VAMP221 & 321)	3 current inputs, 1 trip relay, flush mounting
VAM 10L	Point sensor I/O unit (VAMP221 & 321)	10 sensor inputs, 1 trip relay
VAM 10LD	Point sensor I/O unit (VAMP221 & 321)	10 sensor inputs, 1 trip relay, flush mounting
VAM 12L	Point sensor I/O unit (VAMP221 & 321)	10 sensor inputs, 3 trip relays
VAM 12LD	Point sensor I/O unit (VAMP221 & 321)	10 sensor inputs, 3 trip relays, flush mounting
VAMP 4R	Interface Unit (use vx002 cable)	4 x NO, 4 x NC, 2 groups
VAR 4 CE 4/0	Interface Unit (use vx002 cable)	1xNO -> 4xNO
VA 1 DA-6	Arc Sensor	Cable length 6m
VA 1 DA-20	Arc Sensor	Cable length 20m
VA 1 DT-6	Temperature Sensor	Cable length 6m
VA 1 DP-5	Portable Arc Sensor	Cable length 5m
VA 1 DP-5D	Portable Arc Sensor	Cable lenght 5m
VA 1 EH-6	Arc Sensor (Pipe type)	Cable length 6m
VA 1 EH-20	Arc Sensor (Pipe type)	Cable length 20m
ARC SLm-x	Fiber sensor, 8 000 lx	x = fiber lenght (1
SLS-1	Fiber joint SLS-1	Max one joint per fibre
VX001-xx	Modular Cable VAM <-> VAM (xx = Cable length [m])	Preferred Cable Lenghts (2
VX031-5	Extension cable for VA1DP-5D	Cable lenght 5m
VYX001	Surface Mounting Plate for Sensors	Z-shaped
VYX002	Surface Mounting Plate for Sensors	L-shaped
VYX076	Projection	Height 40mm
VYX077	Projection	Height 60mm
VYX233	Projection	Height 100mm
3P001	Line amplifier for arc protection BI/O channels	DIN rail mount
3P004	Supply unit, 100-240AC/24DC/1.3A	Supply unit

Note 1. Fibre lengths 1, 5, 10, 15, 20, 25, 30, 35, 40, 50, 60 or 70 m
Note 2. Cable lengths 1, 3, 5, 7, 10, 15, 20, 25 & 30

12. Appendix/ Earthing instruction

The following mentioned I/O units should be earthed to switchgear earth as below:

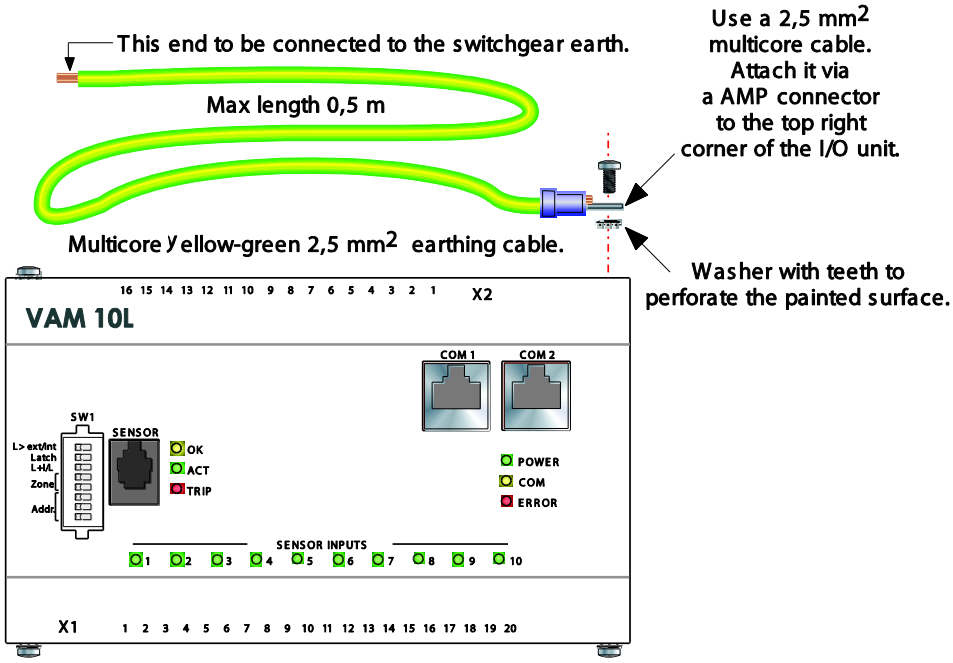
ALT 1.



Earthing instruction 1

REM ! If the earthing potential varies in the switchgear installation, the earthing should be done from master (VAMP221), in parallel with the communication cable (VX001). In this case the dinrail connection between slaves and switchgear should be isolated!

ALT 2.



earthing instruction 2

If the switchgear earthing solid !

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